Scranton Gillette Publication MARCH 1958

WATER & SEWAGE WORKS

UNIVERSITY MICROFILMS
313 N. 1ST ST.
ANN ARBOR, MICH.
COMP

▲ **TWELVE SAND FILTERS polish the water at the new 50 mgd Big Walnut Treatment Plant in Columbus, Ohio. Now completing its first year of operation, this plant takes water from the Hoover Reservoir about 3½ miles away.** p. 87

News Summary p. 5A **Equipment News p. 9A**

New Bulletins p. 29A

LOCK JOINT ECONOMIES—One of a Series

Low cost operation

Whether it be shining shoes, or a multi-million dollar industry, operational costs can spell the difference between success and failure. That is why so many government agencies, municipalities, private water companies, and industries have turned to LOCK JOINT CONCRETE PRESSURE PIPE.

The dense walls of Lock Joint Concrete Pressure Pipe resist electrolysis and soil corrosion. They also protect steel reinforcing of such conservative stress design that danger of bursting is virtually negligible. Result: replacement or even repair is a rarity, and danger of sudden failure which often entails extensive damage is held to a minimum.

Smooth concrete inner surfaces which cannot tuberculate make the pipe's initial high carrying capacity permanent. Result: low pumping costs and full capacity in the future when even greater demands may be made on the line.

Long life, permanent high carrying capacity and minimal maintenance represent highest quality service at lowest operational cost. This measure of a successful water works system can be yours with LOCK JOINT CONCRETE PRESSURE PIPE.

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East Orange, New Jersey

Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col. • Detroit, Mich. • Hartford, Conn. • Kansas City, Mo. • Perryman, Md.

Pressure • Water • Sewer • REINFORCED CONCRETE PIPE • Culvert • Subaqueous

HOW TO SELECT WATER-CONDITIONING EQUIPMENT (NO. 5 OF A SERIES)

Ion Exchange Equipment

Ion exchangers are solids which can take a "charge" of cations or anions from one liquid and exchange them for different ions of the same polarity in another liquid. Example: "Permutit Q" Cation Exchanger, a sulfonated polystyrene resin. When operated on the "sodium cycle," this resin picks up calcium, magnesium, iron, manganese or aluminum cations from water containing these materials and gives off sodium cations in exchange. When exhausted, the resin is regenerated with a brine (sodium chloride) solution that supplies new sodium cations.

The Table below lists ions commonly found in water and the ion-exchange systems by which they can be removed.

Softening: Removing calcium and magnesium ions that cause boiler scale, soap curd, etc. Done with a cation exchanger, sodium cycle, which also removes iron, manganese and aluminum ions.

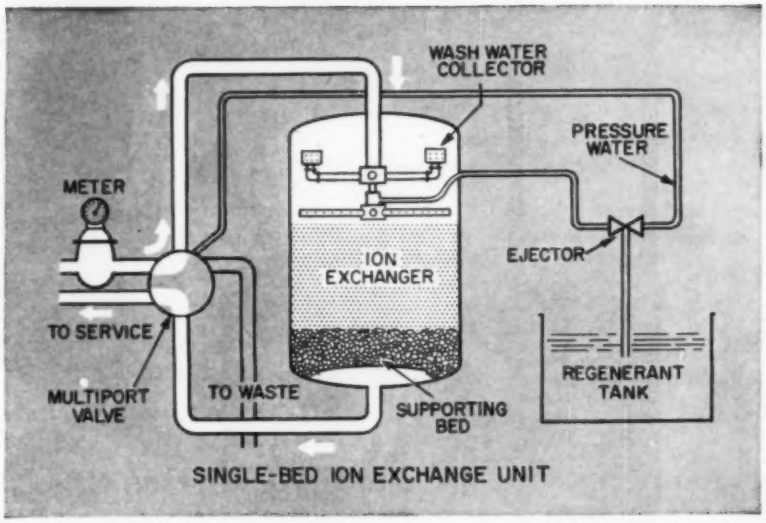
Dealkalizing: Removing bicarbonates and carbonates, generally from boiler feedwater, to reduce corrosion due to CO_2 in condensate returns. Done in 2 steps: cation exchanger, sodium cycle, then strongly basic anion exchanger, chloride cycle.

Demineralizing: Removing cations and anions. Up to nine or ten combinations of exchangers with one to four steps are used depending on the raw water and the degree of purity required for a specific use.

Functions of equipment

Ion exchange equipment is designed to accomplish these basic cycles: The *service run* during which the water flows through the bed of ion exchanger (usually downflow); *backwashing* (upflow) for removing suspended solids filtered out by the ion exchanger; *regenerant introduction* (either upflow or downflow) which restores the capacity of the ion exchanger and *rinsing* which removes the excess regenerant from the bed.

A manual or automatic motor-driven multiport valve replaces a number of individual valves and greatly simplifies regeneration. Rubber-lined multiport valves are used under corrosive conditions.



SINGLE-BED ION EXCHANGE UNIT

Length of service run is usually controlled by the volume of water through an electric-contact water meter or by automatic water-quality testing instruments such as a conductivity meter.

SINGLE-BED UNITS for softening, dealkalizing, demineralizing

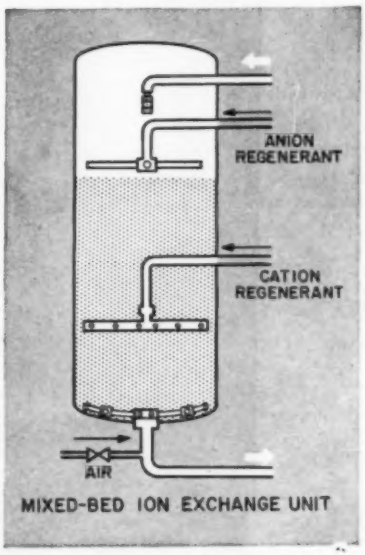
These units contain one type of ion exchanger (cation or weakly basic anion or strongly basic anion). They are similar to pressure filters with ion exchanger in place of the sand and a more efficient distribution and collection system for more uniform flow through the bed.

Two or more single-bed units are required for demineralizing . . . one or more for a cation exchanger and one or more for each type of anion exchanger used.

MIXED-BED UNITS for demineralizing

Mixed-bed units contain both cation and anion exchangers. These are thoroughly mixed prior to the run and provide a multiple-step demineralization.

Backwash rate is closely controlled so that it separates the ion exchanger resins by lifting the lighter anion resin beds over the heavier cation resin. The beds are then regenerated and rinsed while separated, then mixed by air jets from the bottom of the tank and given a final downward rinse before the service run.



MIXED-BED ION EXCHANGE UNIT

CATIONS	Calcium Ca^{++}, Magnesium Mg^{++}, Iron Fe^{++}, Manganese Mn^{++}, Aluminum Al^{+++}	Exchanged for sodium ions by CATION EXCHANGER regen. with sodium chloride.	Exchanged for hydrogen ions by CATION EXCHANGER regen. with acid.	
	Sodium Na^{+}, Potassium K^{+}			
ANIONS	Chloride Cl^{-}, Sulfate $SO_4^{=}$, Nitrate NO_3^{-}	Taken up as complete acid molecule by WEAKLY BASIC ANION EXCHANGER regen. with soda ash or caustic.	Exchanged for chloride ions by STRONGLY BASIC ANION EXCHANGER regen. with sodium chloride.	Exchanged for hydroxyl ions by STRONGLY BASIC ANION EXCHANGER regen. with caustic.
	Bicarbonate HCO_3^{-}, Carbonate $CO_3^{=}$			
	Silicate $HSiO_3^{-}$			

For information on ion exchange resins and equipment, as well as other water-conditioning equipment, write: The Permutit Company, Dept. W-3, 50 West 44th Street, New York 36, N. Y. or Permutit Company of Canada, Ltd., Toronto 1, Ont.

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COMPLETE PROCESS INSTRUMENTATION

Vol. 105 No. 3

March • 1958

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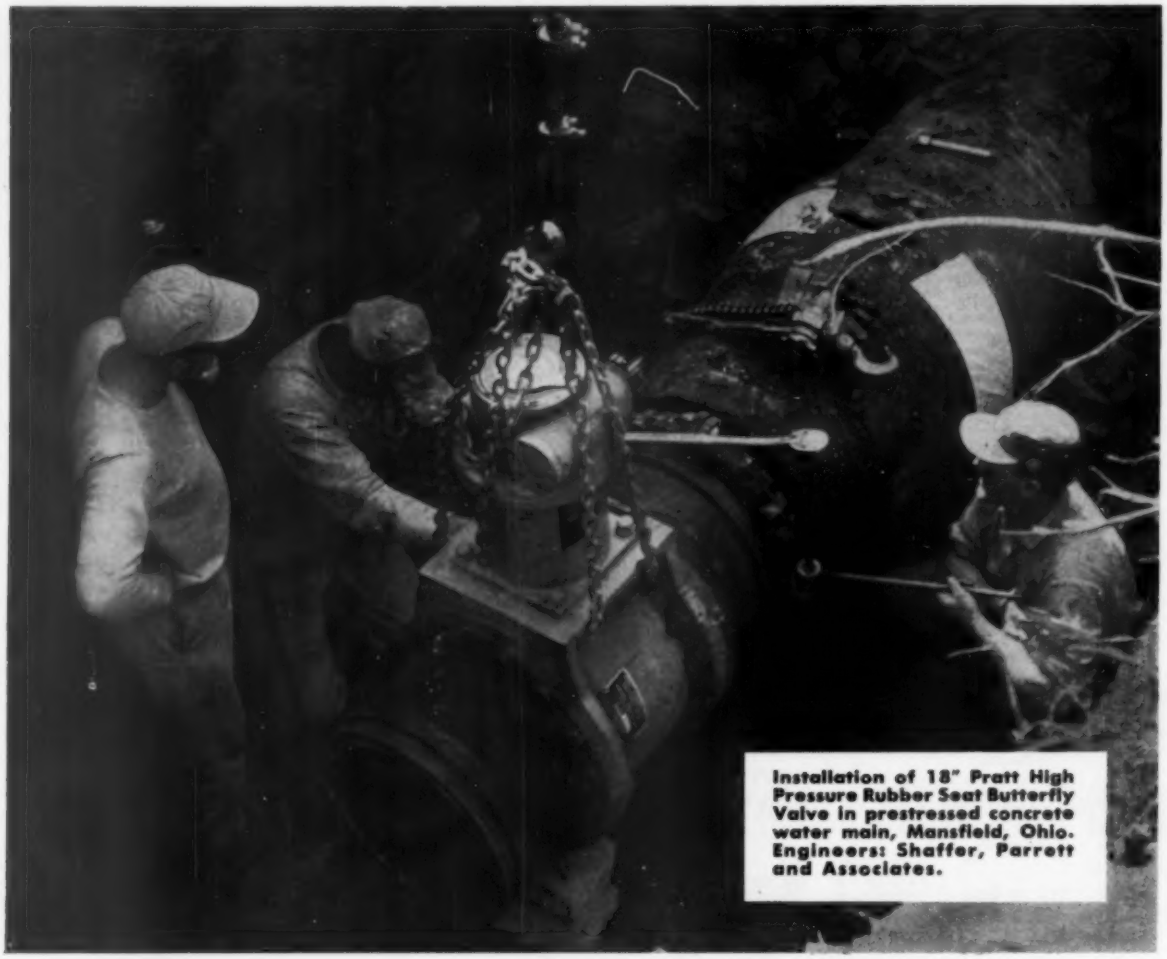


Installation of 18" Pratt High Pressure Rubber Seat Butterfly Valve in prestressed concrete water main, Mansfield, Ohio. Engineers: Shaffer, Parrett and Associates.

MANSFIELD . . . Pratt Butterfly Valves meet all specs for distribution service

The real test of a distri ution valve is its ability to operate when needed. Valves in water distribution service are primarily emergency measures, normally left either open or closed for months, or even years. Yet, they must operate when needed, often to prevent serious property damage in the event of a broken water main.

Mansfield engineers chose Pratt High Pressure Rubber Seat Butterfly Valves for this rigorous duty because Pratt valves meet all specifications for distribution service. The critical disc edge is a corrosion-resistant material, seating against a heavy, mechanically retained rubber liner to provide *permanent, drop-tight shutoff.* The stainless steel valve shaft rotates in bronze bearings, self-lubricated for life, and the valve operator is permanently lubricated and sealed. These features are your assurance of easy operation when you need it . . . features that are built into Pratt valves with the experience that comes with 30 years of leadership in butterfly valve design. Specifying Pratt valves puts this experience to work for you.

NEW! Latest, most accurate pressure drop and flow data, conversion tables, discussion of butterfly valve theory and application plus other technical information . . . **Manual B-2B.**

HENRY PRATT

RUBBER SEAT Butterfly Valves

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities

NEWS SUMMARY

The 1957 Index is still available, copies may be obtained by writing our editorial office at 155 E. 44th Street, New York 17, N. Y.

Big Walnut Water Treatment Plant in Columbus, Ohio, will soon complete its first year of operation and both the plant and its operations are described—page 87.

Radioactive Rains in Iowa have been studied following nuclear tests in Nevada and have been found to have a noticeable effect on surface supplies—page 92.

Consumer Complaints are met by different steps in different communities and for different causes but there always exists a necessity of adhering to the principle of maintaining friendly customer relations—page 95.

Distribution System Extensions present problems of policy and practice. A consulting engineer's viewpoint toward both may depend on the state in which he works. Attitudes in New York State are expressed—page 100.

Distribution System Leakage has an irreducible minimum, but leakage control is desirable and with a proper program can be done with system personnel—page 104.

Pump Efficiencies of centrifugal pumps can be checked by a simple method which is described on—page 107.

Sewage Effluent Dilution in sea water may be practiced with success if formulas for computing dilution are followed and the results obtained with respect to bacterial decline are predictable—page 116.

Sewer System Maintenance was surveyed in Louisiana and from this survey recommendations were developed for personnel needed, costs, inspection and practice—page 123.

Sometimes I think I'm getting too old to work for this outfit.

Some day you're going to argue once too often with those boys about that new plastic tubing.

A GOOD COMBINATION

for better performance—lower operating costs . . .

LEOPOLD FILTER BOTTOMS

Designed to successfully meet all underdrain requirements

Made of de-aired fire clay—vitrified and salt glazed, the Leopold Filter Bottom is unequalled for dependable, economical service. The individual blocks resist corrosion, are not subject to tuberculation, and will last indefinitely. Too, they require only small sized gravel, do not need special supporting concrete members, and the Leopold design insures uniform wash distribution.

LEOPOLD
Rubber Seated
BUTTERFLY VALVES

Assure positive drop-tight shut-off easily, efficiently, economically.

In this design, the seat is of resilient Neoprene rubber or pure gum rubber, vulcanized around a steel ring insert, and held in place by a keeper ring. The steel ring, which is "continuous" to eliminate abnormal wearing, increases the firmness of the seat and assures longer service life.

Whether operated manually or by automatic controls, Leopold Butterfly Valves always provide a positive shut-off that's bubble-tight. Made in sizes 6″ to 96″.

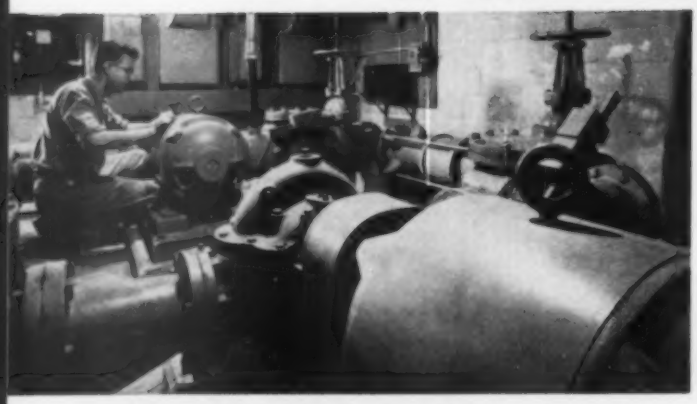
Meet AWWA Specifications C504-55T

Write today for descriptive literature!

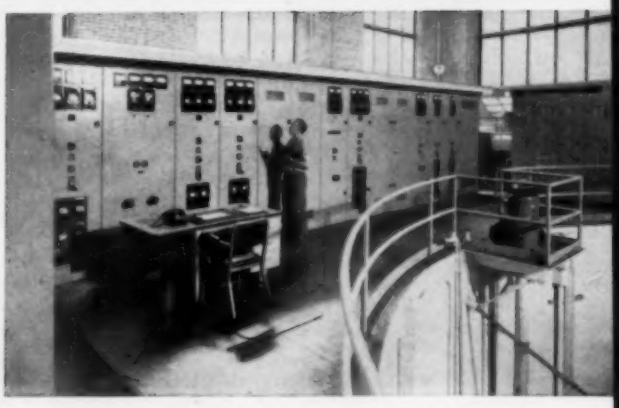
Leopold

F. B. LEOPOLD CO., INC.
Zelienople, Pa.

View at Nadine Pumping Station shows south pump pit containing pumps No. 2 and No. 3 with Westinghouse metal-clad switchgear and control center for all station pump motors in background.



Close-up view in booster station shows two 40-hp Westinghouse motor-driven booster pumps, Westinghouse safety switches, motor starters and power factor correction capacitor.



Metal-clad switchgear includes: incoming line section; starting breakers for 1000- and 1250-hp synchronous motors and their auxiliary field control cubicles; starting and running breakers and reactors for two 2500-hp motors.

Water pumping station saves $66,500 annually by Powering-Up electrically

The need for extensive modernization and expansion of water pumping facilities at Nadine Pumping Station of The Wilkinsburg-Penn Joint Water Authority brought about a complete change from steam to electric motor-driven pumps. One new 6.5-mgd pump was added to the three already in use to increase total capacity to 52,000,000 gallons per day.

In addition to the benefits of increased capacity and complete station electrification, comparative figures show a reduction in annual operating costs from approximately $268,000 to $201,500, for a savings of $66,500 per year. This represents an annual return of about 19% on the modernization cost of approximately $350,000. This fast five-year amortization of the investment eliminated the necessity of bond issues or other financing.

Besides the four new pump motors supplied by Westinghouse, the station now contains a line-up of 5-kv metal-clad switchgear, a 150-kva dry-type power center transformer, a motor control center for auxiliary power and a station battery and automatic battery charger.

The electrical Powering-Up of this pumping station has also made possible a more flexible discharge piping arrangement and the electric operation of valves and other equipment.

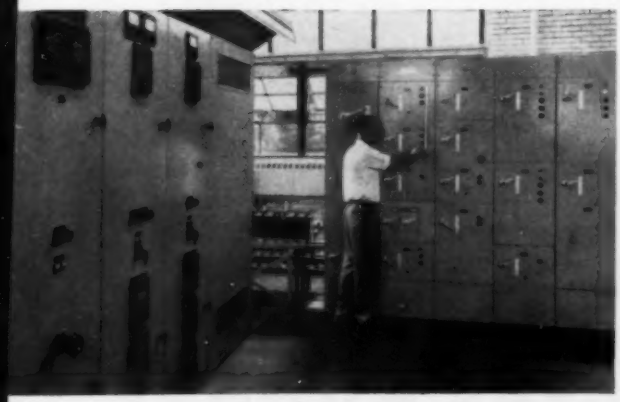
Powering-Up electrically can mean similar important benefits and savings for you. For further information, call the Westinghouse electrical construction engineer nearest you. He can help you in your Power-Up program. Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa.

Owner: The Wilkinsburg-Penn Joint Water Authority
Consulting Engineers: Morris Knowles, Incorporated
General Contractors: Dravo Corporation
Electrical Contractor: Morganstern Electric Co., Incorporated

J-94088

YOU CAN BE SURE...IF IT'S Westinghouse

Over 250 Pages
Westinghouse Data
In Sweet's Construction File.



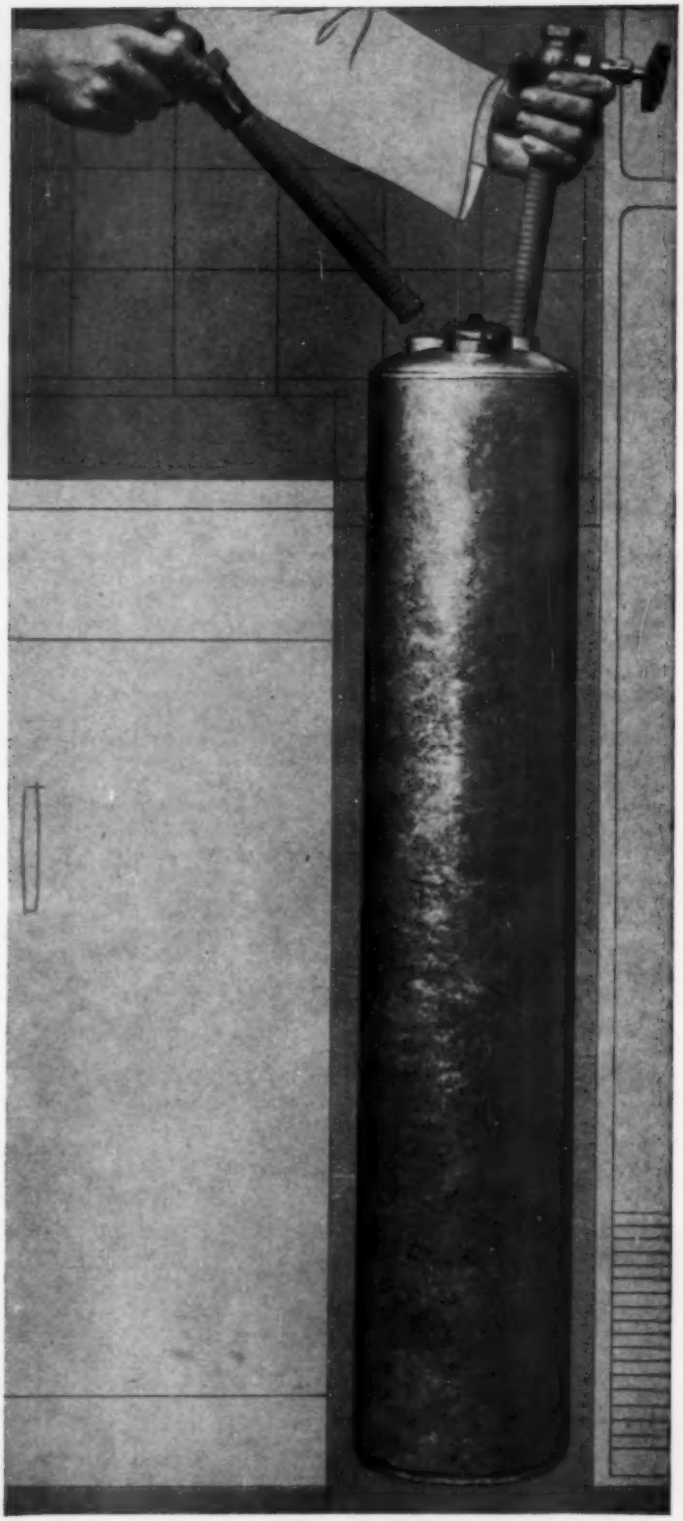
Shown at left is metal-clad switchgear feeder cubicle and 150-kva dry-type transformer. Motor control center at right contains motor starters and feeder breakers for various station auxiliaries.

Engineering group shown includes: George A. Maibach, Chief Engineer, Nadine Pumping Station; G. V. Gustafson, Morris Knowles, Inc., Consulting Engineers; M. B. Trimble, Westinghouse Construction Sales Engineer.

USCOLITE PIPE

MR. USCO REPORTS:

THE PIPING that never needs replacement



To handle the highly corrosive brine used in regenerating this Cesco Water Softener, two lengths of Uscolite thermoplastic pipe are used. Uscolite is so highly resistant to the brine that *not one section of it has ever had to be replaced!* And there's no possibility of electrolysis due to the use of dissimilar metals. In fact, Uscolite® Pipe remains in such perfect condition that when the water softener tanks require replacement, the pipes are removed and used in new units.

Uscolite thermoplastic pipe is a product of United States Rubber. It is highly resistant to most chemicals, is extremely light, yet has very high impact strength. It just never seems to deteriorate.

A complete line of pipe and fittings (including unique UscoWeld* solvent-weld fittings)—plus the assistance of trained sales engineers who *know plastics*—is available at selected "U.S." Distributors, at any "U.S." branch, or contact us at Rockefeller Center, New York 20, N. Y. In Canada, Dominion Rubber Co., Ltd.

National Sanitation Foundation Seal awarded to Uscolite Pipe

*Patent applied for.

Mechanical Goods Division

United States Rubber

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Equipment News

Prefabricated Asphalt Liner For Heavy-Duty Service

301

Presstite-Keystone Engineering Products Co., St. Louis, Mo., has developed a prefabricated asphalt liner, called Aqualiner, designed for heavy duty service in the positive containment of water, brines, sludges, wastes or sewerage. According to the manufacturer, the scope of applications of this new liner is limited only by the imagination.

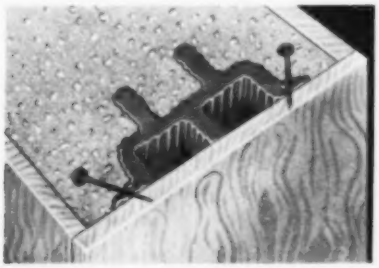
Aqualiner is a heavy duty asphalt mastic sheet which, for added toughness and ease of handling, is surfaced with asphalt-saturated felt liners. The liner is coated with a high-melt-point, weather-resistant asphalt film to give added resistance to the exposure conditions such as are encountered in reservoir, canal, and related installations.

The liner is available in two thicknesses, ½ and ¼ in, in 4 ft. widths. It is factory cut as required by the job.

Plastic Waterstop Permanently Prevents Seepage

302

Water Seals, Inc., Chicago, Ill., has developed a new type of polyvinyl plastic Labyrinth waterstop that can



be installed in a matter of seconds by simply attaching to the inside of the temporary terminal board by driving nails partway in, leaving the heads projecting enough to become embedded in the concrete pour. This prevents strain on the waterstop when pulling the board off for the next pour.

The polyvinyl plastic is flexible and tough, and takes care of expansion and contraction. It is not affected by temperature changes nor by any acids normally encountered. It is resistant to aging and will last as long as the concrete itself.

A special advantage is its ability to be fused together, forming a bond practically as tough as before cutting. Pieces may be fused with equal ease, with a hot putty knife, when mitered or formed into a T joint.

Magnetic Flowmeter for Difficult Liquids

303

Fischer & Porter, Hathboro, Pa., has developed a new Magnetic Flowmeter that accurately measures the flow rate of "difficult" liquids such as acids and slurries without adverse effects to the meter.

The major features are: manual adjustment for setting any desired flow rate at full scale (The 1" meter can be set to handle from 3 to 40 gpm at full scale; the ½" meter as low as one gpm.); unrestricted flow; readings unaffected by velocity profile, density, or viscosity; voltage changes between 90 and 125 volts and frequency changes between 55 and 65 cycles have no effect on readings; special piping for long metering runs is not required; flow can be measured in either direction.

Automatic Fluoride Analyzer

304

Hach Chemical Co., Ames, Iowa, has developed an automatic fluoride analyzer for the continuous reading and recording of fluoride.

The unit is based on the Megregian-Maier method, and provides for direct reading on a 4½ in meter at 0 to 2.0 fluoride.

Simple to connect and maintain, the unit needs only connection to water, drain and 110 v A.C. It has no moving parts, valves or motors, and only requires about 3 minutes attention daily.

CONTINUED ON PAGE 11A

ORDER ONE
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SAVE MONEY, TIME, CALL-BACKS!
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Surer Gland Lubrication for Centrifugal Pumps

THE Z-F GREASE SEAL eliminates that trouble spot where shaft enters casing. Applies constant positive lubrication to packing and shaft—automatically. Excessive heat, rapid wear, leakage and scoring will disappear as the Grease Seal applies a constant flow of lubrication when pump starts until it stops—automatically. Many other advantages, too. Write for complete description and price. **ZIMMER and FRANCESCON, Moline, Illinois.**

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DEPARTMENT OF WATER AND WATER SUPPLY

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WATERS AND ASSESSMENTS
JOHN C. McDONALD
CASHIER

October 25, 1957

Eddy Valve Company
Waterford, New York

Gentlemen:

We are enclosing a picture of a 6" Eddy Valve placed in service some time previous to the year 1851, this being the year the City acquired the Water Supply from a private company.

How many years prior to 1851 this valve was installed is problematical as Cast Iron water mains have been used in this city since the year 1813.

This valve is in the distribution system and is in good working order. In checking over a report of George W. Carpenter, Superintendent of the City Water Works, dated January 16, 1854, we find that valves at that time were called stop cocks.

We thought perhaps you would be interested in knowing about your product.

Very truly yours,
William F. Devane
Commissioner

WFD:k

EDDY valves and hydrants not only give the kind of service that Albany's Water Commissioner William F. Devane tells us about—but Eddy can supply repair parts for any and every valve they ever built.

It is important that future long-time service is a part of what you buy. When your municipality embarks on a waterworks modernization program make sure that the capacity and resources of your equipment supplier are such as to assure its maintenance—even for a hundred years.

That's why Eddy is a good company to do business with. Let us give you the facts and figures.

EDDY AWWA fire hydrants offer these advantages

They open smoothly with the pressure, close without water hammer. Entire operating mechanism is easily removed for inspection and repair *by one man.* Standpipe drains by automatic drip action.

EDDY has everything you need for underground water systems

Quickly available are AWWA gate valves, cutting-in valves and sleeves, tapping valves and sleeves. Call your EDDY man for complete details.

EDDY VALVE COMPANY
A Subsidiary of James B. Clow & Sons, Inc.

WATERFORD NEW YORK

Equipment News

CONTINUED FROM PAGE 9A

Maintenance Truck Bodies

305

Reading Body Works, Inc., Reading, Pa., has developed a new series of improved truck bodies, designed specially for water and sewerage system maintenance. Developed with the cooperation of well-known truck authorities in the field, the "job-planned" bodies include new structural reinforcement features.

Extra rigidity has been added to all 18 utility models by the addition of two full width cross-sills. General construction of the bodies, which range from one-half to one-ton units, is of 12, 14 and 16 gauge steel, with understructure of 12-gauge steel.

Variable compartment and shelving arrangements provide unusually large storage and load areas. Compartment capacity ranges from 35 cubic feet in half-ton models to 68 cubic feet in one-ton models.

Designed for mounting on any standard chassis, Reading all welded units are available in fully enclosed panel bodies with permanent roof or canopy tops for both single and dual wheel chassis. Overall body lengths at the floor line are 78 to 108 inches. Inside floor areas range from 26 to 38 square feet.

Corrosion-Proof Swimming Pool Filter

306

Proportioneers, Inc., Providence, R. I. has introduced a completely new type of corrosion proof swimming pool filter using the new Cryst-L-Clear diatomite vacuum filter.

Fibre glass reinforced plastic is used throughout this vacuum type filter, assuring virtually maintenance free operation throughout the life of the unit.

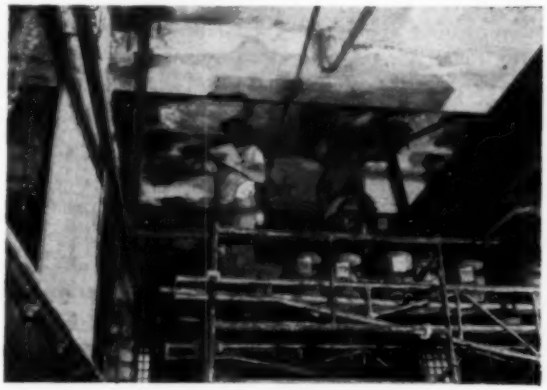
Everything from the filter tank to the filtering elements is impervious to attack from water-treating chemicals and aggressive waters. No protective liners and no paint-maintenance are

CONTINUED ON PAGE 13A

How THORITE and THOROSEAL made this underground structure sound again!

Workmen prepare old surface for patching with THORITE.

Water has entered the concrete and caused corrosion of reinforcing rods, blistering the concrete off surface and causing structural weakness throughout building.



Reinforcing was cleaned, all corrosion was removed and brush coat of THORITE applied over entire patching area, then filled in with trowel coats of THORITE, even with surrounding surfaces.

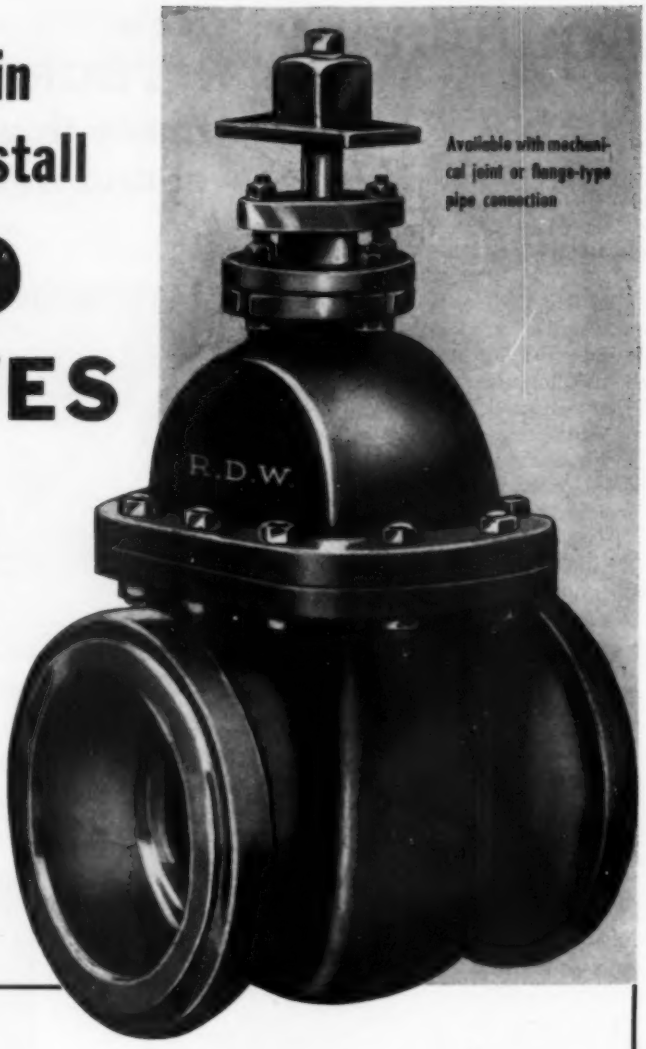
THORITE Patching Mortar sets in 20 to 30 minutes and can be coated with THOROSEAL while hardening.

"How to do it" GET OUR 16 PAGE BROCHURE

STANDARD DRY WALL PRODUCTS, INC.
NEW EAGLE, PENNA. CENTERVILLE, IND.

No interruptions in service when you install

WOOD GATE VALVES



Available with mechanical joint or flange-type pipe connection

Because of their inaccessibility underground, repairs to gate valves are always time-consuming, expensive, and a source of annoyance. And interruptions in service while repairs go on are hazardous for the community.

For these reasons, R. D. Wood Gate Valves are designed to function for generations no matter what the conditions. They are rugged in construction, fully bronze mounted, and tested to 300 lb. hydrostatic pressure. Designed for working pressures conforming to AWWA specifications.

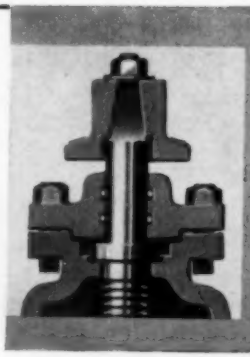
SIMPLE IN DESIGN

Only three moving parts—a spreader and two discs which are free to revolve their complete circumference while being raised or lowered. Gates are lifted clear of valve seats, providing unobstructed flow.

R. D. WOOD COMPANY

Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)



R. D. Wood Gate Valves also available with O-Ring Stuffing Box seal when specified.

Equipment News

CONTINUED FROM PAGE 11A

required, making the Cryst-L-Clear pool filter very economical in service.

The vacuum operating principle is also a cost-saving feature, reducing horsepower requirements at least in half. The filtering unit is of open-top design. All elements, baffles, and mechanical parts are fully visible and accessible for inspection or cleaning. The diatomite filtering system produces a sparkling clear and inviting pool water . . . even sub-micron turbidity is removed.

Airslide Conveys Materials Horizontally

307

Fuller Co., Catasauqua, Pa., has announced that fine, dry materials can now be conveyed horizontally without moving parts because of a new Airslide development.

Utlizing a series of high capacity fluidizing floor courses connected by elevating passageways, the new horizontal-type fluidizing conveyor can be arranged to avoid obstructions in the path of the conveyor either by conveying the material around an object or by elevating the material over it in successive elevating steps.

Heart of the conveyor is the elevating passageway. These passageways extend upwardly from the lower or downstream end of each floor course to just above the higher or upstream end of the next floor course. In this way, Airslides can now be used in plant areas with limited head room.

Foam Control in Sewage Aerators

308

National Disinfectant Co., Dallas, Texas has developed DF-12 for foam control in sewage aerators.

DF-12 is a liquid chemical formulated for the control in aerator tanks. Easily applied it assures good knockdown of foam. It is economical and simple to use and is recommended for foam problems regardless of the altitudes or temperatures of the region where foam is to be controlled. Packaged in convenient 55-gallon steel containers, it is safe to use anywhere in the sewage plant.

Gate Valves

309

Darling Valve & Manufacturing Co., Williamsport, Pa., has developed, after approximately two and a half years of development work and testing, accompanied by limited production for special purposes, gate valves of aluminum alloy.

According to the company, the Darling aluminum alloy gate valves currently available range from ½ inch through 24 inch sizes and include types for every requirement where aluminum piping systems are now being used or planned.

These new aluminum alloy valves incorporate the principle of fully revolving double disc parallel seat gate valve operation.

Also, very sizeable savings are possible, particularly in large valves, compared with valves or other metals suitable for the handling of problem gases and fluids. The savings not only accrue in the shipping, handling and installation of the lighter weight aluminum alloy valves, but also pertain to their initial cost due to basic weight and material cost factors in manufacture.

Vertical Boom, Crawler Ditcher

310

Barber-Greene Company, Aurora, Ill., has developed a new vertical boom, crawler mounted ditcher, as an addition to their wide line of crawler and rubber tire mounted, vertical boom, wheel and ladder ditchers.

A complete new design, the Model 784 embodies the basic chassis of Barber-Greene's Model 774 wheel-type ditcher which was announced early in 1957. If desired, the Model 784 vertical boom may be removed and the 5 ft 6 inch digging wheel of Barber-Greene's Model 774 wheel-type ditcher may be substituted.

The vertical digging boom offers many new design features as well. It offers a maximum digging depth 7 ft and bucket widths of 19, 21 and 24 inches. This variation in digging widths is achieved with a single bucket

CONTINUED ON PAGE 21A

When this Nameplate goes into place . . .

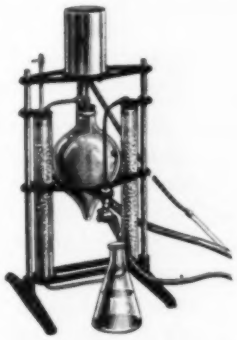
YOU KNOW YOU HAVE *the Best*

ROBERTS FILTER MANUFACTURING CO.

607 COLUMBIA AVE.
DARBY, PA.

ENSLOW

STABILITY INDICATOR

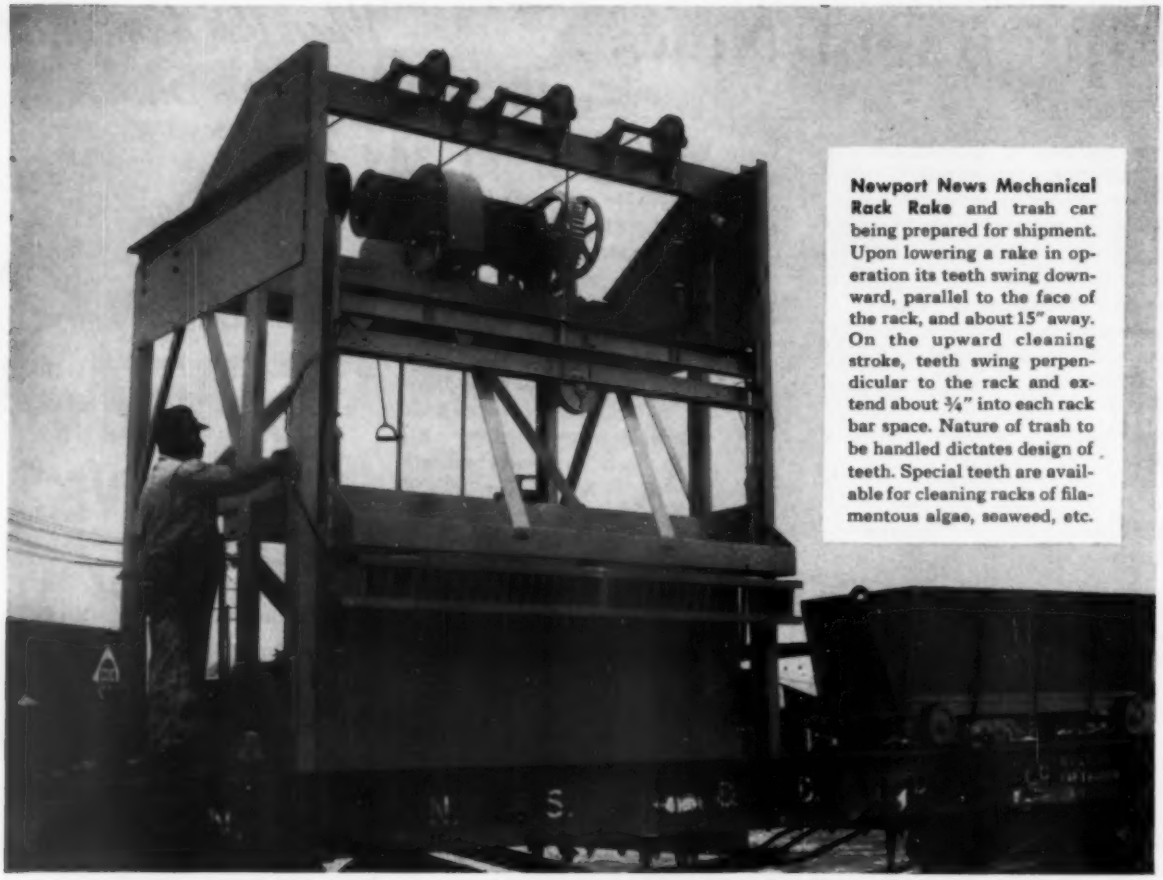


For checking the equilibrium of a finished water, and supplying an index useful in controlling anti-corrosion treatment. Catalog No. 83-895

WRITE:

Phipps & Bird, Inc.

P. O. Box 2V Richmond 5, Va.



Newport News Mechanical Rack Rake and trash car being prepared for shipment. Upon lowering a rake in operation its teeth swing downward, parallel to the face of the rack, and about 15" away. On the upward cleaning stroke, teeth swing perpendicular to the rack and extend about ¾" into each rack bar space. Nature of trash to be handled dictates design of teeth. Special teeth are available for cleaning racks of filamentous algae, seaweed, etc.

Positive cleaning action calls for guided rack rakes

Excessive loads of trash cannot push a Newport News rake away from the racks.

And there's no chance of the rake *riding over trash* on the upward cleaning stroke. Nor will its teeth drop the debris. Because Newport News builds the rake to operate in channel guides... for *positive cleaning action.*

That's why efficient rack cleaning assures the maximum head at intakes and is yours when you put a rugged and dependable Newport News Mechanical Rack Rake on the job.

Maximum width of a single rake is determined by design of the forebay. Where a single bay is extremely wide, intermediate guides are sometimes installed to reduce width of the rake. Such installation is relatively inexpensive.

A power-operated Newport News Mechanical Rack Rake, under ordinary conditions, enables one man per shift to keep racks clean for a dozen bays, from 5'-6" to 28'-6" in width.

Trash is cleaned from the rake manually, or by a mechanical "sweep", into a flume, a car or onto a trash apron. Local conditions and nature of the trash dictate method of disposal. The many typical installation arrangements fit most needs, but each installation is a custom built job.

We invite inquiries from water users who are troubled with trash. Write for your copy of "RACK RAKE", an illustrated booklet describing the operation and advantages of the Newport News Mechanical Rack Rake.

Newport News
Shipbuilding and Dry Dock Company
Newport News, Virginia

Forests Protected . . .

but how about our most precious possession . . . water?

You'll save water—increase the system income—with Badger Meters

Forest conservation costs millions — and it's worth it. But the millions of *wasted gallons* of increasingly scarce water *could* cost the future of entire communities. Yet one basic step—replacing flat rates with Badger Meters — sharply reduces waste. Water revenue rises. And because they are Badger Meters, peak meter performance is assured for years.

Badger Meters have an unsurpassed record for low maintenance cost: ruggedly built of finest copper alloy. Control adjustment is simple. Working parts are few and standardized for easy, inexpensive replacement if ever needed.

By thus installing the finest meters available—Badger Meters—you put the department on an efficient, good-business basis, while saving vital water supplies through fair-share, fair-pay metering. Act now! Write for literature or to arrange a helpful consultation with a Badger Meter representative.

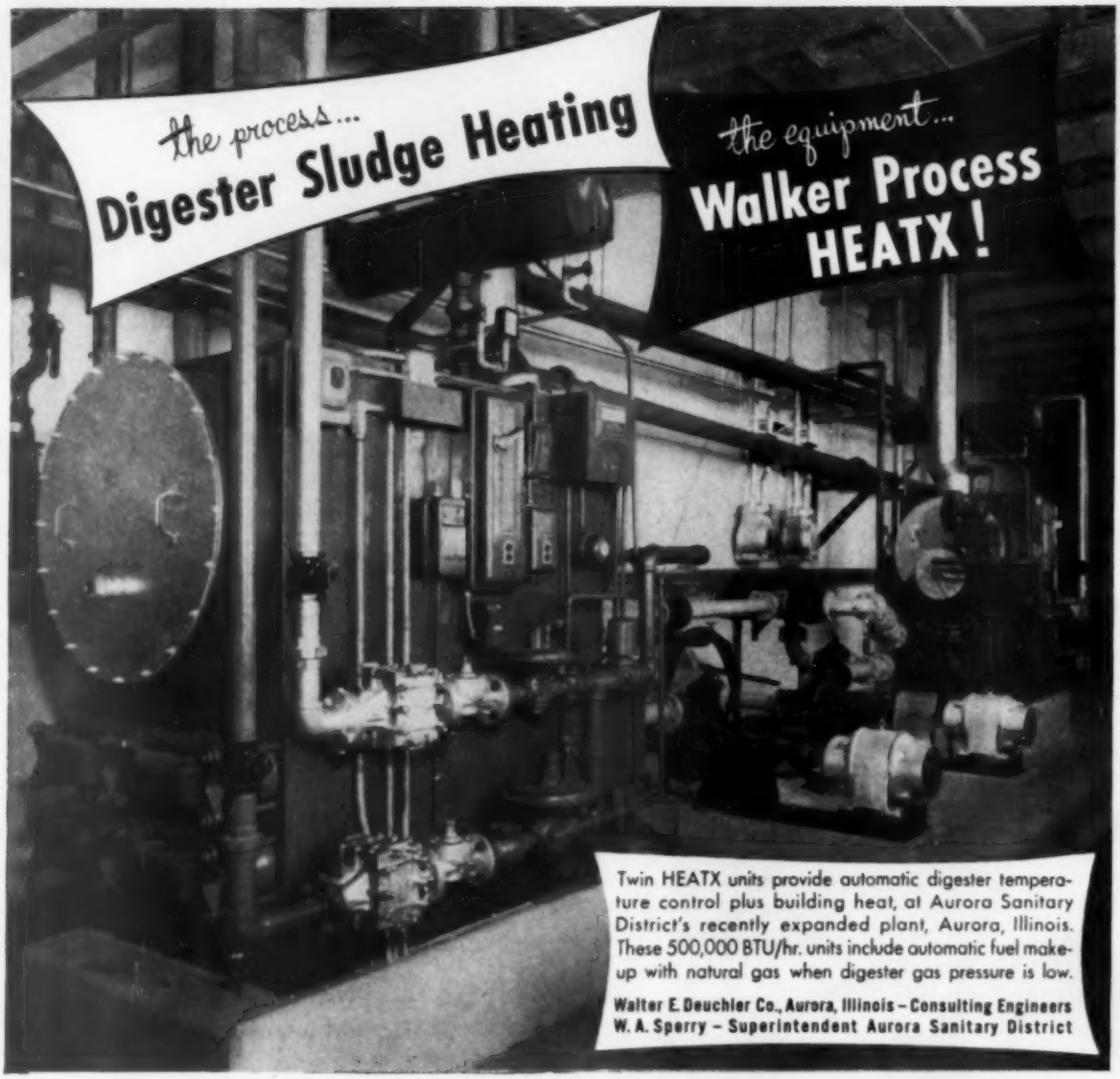
Outstanding disc, turbine and compound meters—⅝" through 12" —precision-engineered for lasting service.

Water is vital

Badger Meters have conserved it better for over 50 years.

Badger Water Meters

BADGER METER MFG. CO. — 2371 North 30th Street
Milwaukee 45, Wisconsin • OFFICES IN PRINCIPAL CITIES



Twin HEATX units provide automatic digester temperature control plus building heat, at Aurora Sanitary District's recently expanded plant, Aurora, Illinois. These 500,000 BTU/hr. units include automatic fuel make-up with natural gas when digester gas pressure is low.

Walter E. Deuchler Co., Aurora, Illinois – Consulting Engineers
W. A. Sperry – Superintendent Aurora Sanitary District

Automatic digester temperature control ■ 180°Boiler heat for building heat

HEATX

140°Exchanger temperature prevents sludge caking
Adaptable to waste heat utilization
Exclusive rifled sludge return bend castings

Maximum efficiency using digester gas and/or natural gas or fuel oil

The Walker Process HEATX provides the *complete unit* for your digester sludge heating process. Concentric tube heat exchanger, fire tube boiler and control panel are combined to give absolute control over each function. Exclusive ***rifled*** sludge return bend castings cause sludge to spiral through the exchanger tubes – better K value – wall scouring prevents slime and grease adhesion. ■ The HEATX is available in standard sizes ranging from 100,000 to 2 million BTU/hr. output. Bulletin 24 S82 gives complete description of type EB (with boiler) and type E (without boiler)

WALKER PROCESS

WALKER PROCESS EQUIPMENT INC.
FACTORY • ENGINEERING OFFICES • LABORATORIES
AURORA, ILLINOIS

BADGER METER MFG. CO. — 2371 North 30th Street
Milwaukee 45, Wisconsin • OFFICES IN PRINCIPAL CITIES

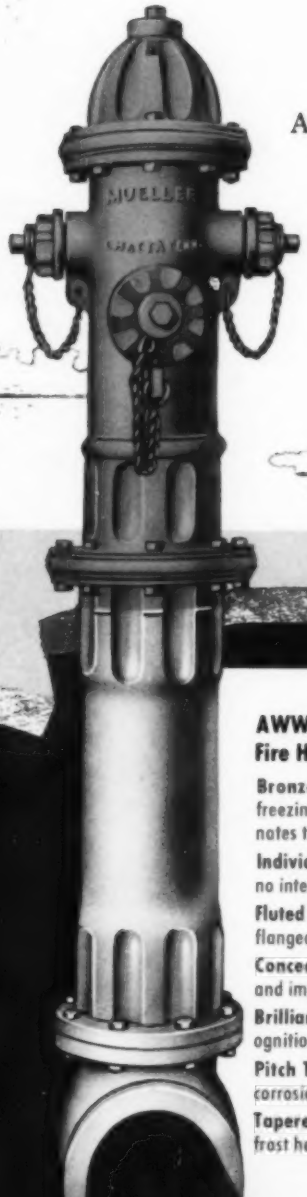
standardize on

MUELLER®

AWWA fire hydrants
and gate valves

For assured dependability, standardize on Mueller AWWA Fire Hydrants and Gate Valves for municipal, industrial and private fire protection and water supply systems. Precision-engineered, these products equal or exceed the exacting specifications of the American Water Works Association.

MUELLER CO.
DECATUR, ILL.



AWWA Improved Fire Hydrants

Bronze Weather Cap — prevents freezing of operating nut and eliminates tampering.

Individual Non-kinking Chains — no interference with other caps.

Fluted Design—ribs add strength at flanged joints.

Concealed Flanges—keep out dirt and improve appearance.

Brilliant Enamel Finish—aids recognition and resists weather.

Pitch Tar Varnish Finish—resists corrosion below ground.

Tapered Lower Barrel — prevents frost heave.

AWWA Gate Valve

Heavy Cast Iron Body — ample strength to withstand pipe movement.

Pitch Tar Varnish Finish — resists corrosion.

Cadmium Plated Bolts and Nuts — give greater resistance to corrosion.

Fully Bronze Mounted — reduces wear and corrosion.

Parallel Seat—Double Disc Type — preferred for water works use.

Four Point Wedging Mechanism — assures positive shut-off.

Pinned Disc Assembly — valve operates in any position.

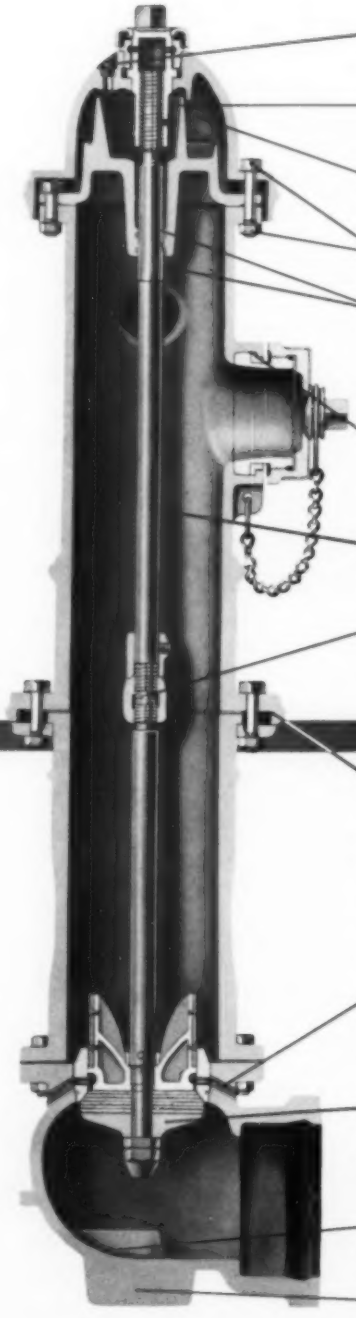
MATCHED IN QUALITY

MUELLER

AWWA improved fire hydrants

Compare the many features of Mueller Fire Hydrants with those of ordinary hydrants. Compare the standard features . . . then compare the exclusive bonus features that have given Mueller Fire Hydrants an unequaled reputation of dependability and safety. Compare—and you, too, will standardize on Mueller AWWA Improved Fire Hydrants.

designed for above-ground maintenance!



- **Oil Filler Plug** . . . permits instant check of oil level with dipstick. Oil may be added without removing bonnet.
- **Oil Reservoir** . . . provides positive lubrication of all stem threads and bearing surfaces each time the hydrant is operated.
- **Dry Top Design** . . . threads and all bearing surfaces are sealed away from the water in the barrel.
- **Cadmium Plated Bolts and Nuts** . . . give greater resistance to corrosion.
- **"O" Ring Seals** . . . give permanent, water-tight seal by bearing against a bronze sleeve brazed to the top of the stem. Packing adjustments, binding of stem, stuffing box bolts and glands are completely eliminated.
- **Breech-Locked Nozzles** . . . four lugs lock bronze nozzle into barrel with a ⅛ turn to positively prevent blow-out. Nozzles are then calked with lead.
- **Full Flow Opening** . . . large radius hose and pumper openings reduce frictional loss to a minimum.
- **Safety Stem Coupling** . . . opens up to prevent damage to stem when hydrant is hit by a vehicle. Can be replaced in minutes without water shut-off.
- **Safety Flange** . . . breaks cleanly to prevent barrel breakage when struck by a vehicle, yet is strong enough to withstand normal use, shipping and testing. Permits economical repair, adding of extension sections, rotating of upper barrel section, changing of upper barrel section for different nozzle arrangements—all without digging or water shut-off.
- **Double Drain Openings** . . . fully bronze mounted. Annular drain groove in seat ring connects drain openings in ring and shoe. Openings are momentarily force-flushed each time hydrant is operated.
- **Compression Type Main Valve** . . . closes with the pressure—and stays closed without strain on stem. Permits repairs and changes of upper barrel section and operating mechanism without water shut-off.
- **Positive Stop** . . . integrally cast into shoe permits full opening without over-travel of stem.
- **Heavy Shoe** . . . designed for full flow with pedestal base and backing pad for ease in setting and blocking to prevent blow-off.

- **Double Drain Valves** . . . integral part of main valve assembly to give positive, automatic operation without springs, toggle joints or synchronized mechanisms.
- **Resilient Balata Valve** . . . layers of canvas impregnated with Balata resist wear and rock damage and insure a positive shut-off.
- **Bronze Seat Ring** . . . fine threads and copper-asbestos gasket prevent leakage around seat ring in both open and closed position. Straight threads permit easy removal from above-ground. Gasket comes out with seat ring.
- **Bronze Cap Nut** . . . seals bottom of stem and stem threads from water to reduce corrosion.
- **Pin and Guides** . . . prevent stem from rotating during operation of hydrant and eliminate tendency of stem to unscrew from main valve.

DEPENDABILITY

• **"O" Ring Stem Seals** . . . upper "O" ring seals dirt and water from bearing surfaces and acts as a reserve pressure seal. Bottom "O" ring provides a positive water-tight seal to prevent external leakage. The higher the pressure, the greater the sealing force. Conventional packing may be easily converted to "O" ring stem seals.

• **Lubricant Reservoir** . . . the area between the "O" rings is filled with a special, lifetime lubricant. Each time the valve is operated, both "O" rings are completely lubricated. The thrust collar operates in an oil bath.

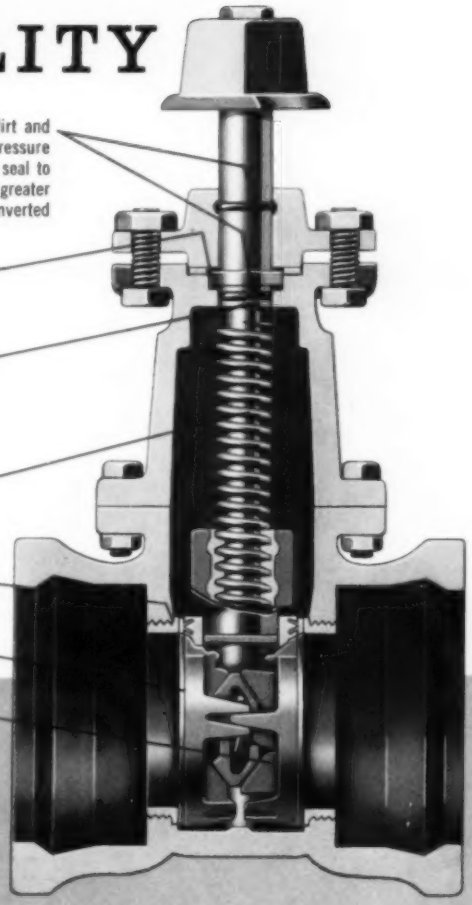
• **Heavy Bronze Stems** . . . are machined from high tensile strength solid bronze rod for all valves up to 16". Electrically upset thrust collar improves grain structure. Valves 18" and larger have stems cast from extremely high tensile strength manganese bronze.

• **Acme Stem Threads** . . . combine high strength and efficiency with self-cleaning ability.

• **Bronze Seat Rings** . . . accurately machined and threaded into body. May be replaced, if necessary, with the proper tools.

• **Bronze Disc Rings** . . . are rolled-in to become part of the disc and are then machined for precise mating with the seat rings.

• **Four Point Wedging Mechanism** . . . exerts even pressure at four points near the outer edge of each disc to eliminate disc deflection and distortion and to assure tight shut-offs. See illustration below.

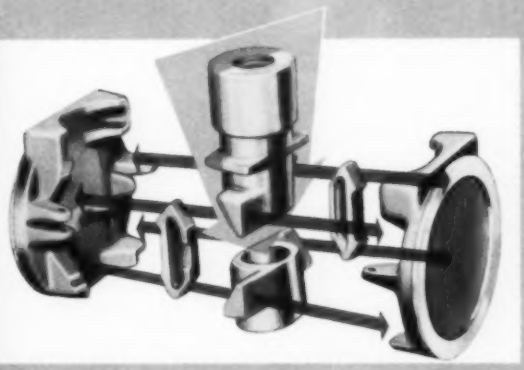


MUELLER

AWWA gate valves

You can forget about the gate valves in your water supply and fire protection systems when they're Mueller Gate Valves. Long-life features, dependability features, ease of operation features add up to maintenance-free service.

designed for minimum maintenance!



• **Exclusive Disc Movement** . . . discs move in an inverted "T" manner, as shown, when valve is opened or closed. The entire disc and wedging mechanism is held together as a unit by special bronze pins passing through interlocking lugs that are cast integrally with each disc. This permits operation of valve in any position. These pins and lugs also control the amount of disc movement. By maintaining a minimum of clearance, discs positively shear incrustations and deposits from seat ring upon closing. Yet, there is no abrasive sliding and scraping contact between disc and seat rings.

• **Husky Wedge Nut Flange** . . . supports entire gate assembly in perfect alignment without strain on wedging mechanism.

• **Opposed Wedges** . . . on top nut eliminate binding or twisting of stem. Nut is free to rotate and the only forces on the stem are straight up or straight down.

whatever your needs

specify **MUELLER**

AWWA IMPROVED FIRE HYDRANTS

- Working pressure: 150 p.s.i.
- Test pressure: 300 p.s.i.
- Inlet ends: Hub, Flanged, Universal, Mechanical Joint, "Ring-Tite" and "Fluid-Tite".

Two Way
Sizes: 4¼", 4½", 5¼", 6¼"

Three Way
Sizes: 4¼", 4½", 5¼", 6¼"

AWWA GATE VALVES

- **Working pressure:** 175 p.s.i.—2" through 12"; 150 p.s.i.—14" through 48"
- **Test pressure:** 300 p.s.i.

Non-Rising Stem

"O" Ring Seals through 36" size without gearing

Conventional packing available on all sizes with or without gearing

Combinations of most end connections available

Hub Ends
Sizes: 2" through 48"

Flanged Ends
Sizes: 2" through 48"

Spigot Ends
Sizes: 2" through 12"

Mechanical Joint Ends
Sizes: 2" through 24"

Universal Ends
Sizes: 2" through 24"

Screwed Ends
Sizes: 2" through 8"

"Right-Tite" Ends
Sizes: 3" through 12"

"Fluid-Tite" Ends
Sizes: 3" through 12"

Outside Screw and Yoke

Conventional Packing only

Hub Ends
Sizes: 2" through 48"

Flanged Ends
Sizes: 2" through 48"

Screwed Ends
Sizes: 2" through 8"

Both Non-Rising Stem and O.S.&Y. Gate Valves may be ordered with either bevel or spur gearing. Grease cases are available for gearing on NRS valves. By-pass Valves are furnished when specified on larger valves.

Consult your Mueller Representative or write direct for complete details.

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles; In Canada: Mueller, Limited, Sarnia, Ontario

FORM NO. W-8879

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Equipment News

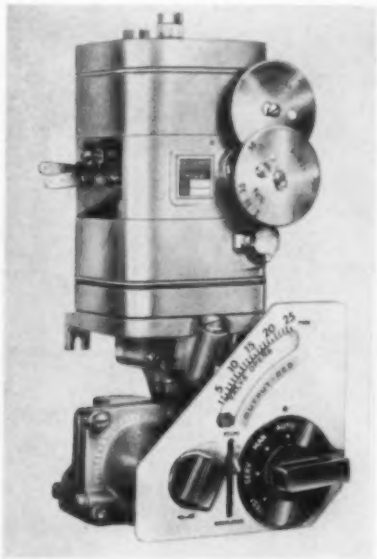
CONTINUED FROM PAGE 13A

line by varying the position or adding teeth to the individual buckets on the digging line.

Pneumatic Controller

311

Fischer & Porter Co., Hatboro, Pa., has introduced an improved motion-balance pneumatic controller with a unique "regenerative feedback" circuit. The new Model 53-P controller



handles both pneumatic and mechanical signals simply by changing one sub-assembly. The same basic design is used with miniature or conventional instruments and provides a complete selection of controller modes including the "Universal."

Portable Submersible Pump For Water and Muck

312

Sumo Pumps, Inc., Stamford, Conn., has developed a new pump which functions effectively on heavy-duty water-pumping operations where dirt, grit or other solids are contained in the water.

It is the Sumo Electrical Submersible Drainer Pump, designed and

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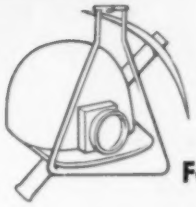
TC TENNESSEE CORPORATION



Ferri-Floc
FERRIC SULFATE

For Reducing TURBIDITY
Caused By SPRING RAINS

The Superior COAGULANT With The Plus FACTORS—

- Excellent taste and odor control
- Increased filter runs
- Coagulation over wide pH ranges
- Rapid floc formation
- Economy
- Turbidity removal
- Color removal
- Manganese and Silicol removal
- Bacteria removal
- Ease of Operation

Ferric salts have proven their ability to coagulate waters of widely varying turbidity. Spring rains increase turbidity for those who must treat surface supplies. The use of Ferri-Floc will simplify the treatment of this high turbidity. Ferri-Floc is partially hydrated Ferric Sulfate that has the ability to convert these high turbidities without radical dosage changes.

Ferri-Floc FERRIC SULFATE

SULFUR DIOXIDE SO_2 SULFUR DIOXIDE

Sulfur-Dioxide is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

COPPER SULFATE

Copper Sulfate will control about 90% of the microorganisms normally encountered in water treatment plants more economically than any other chemical.

FREE BOOKLET

Let us send you without charge, a 38 page booklet that deals specifically with all phases of coagulation — just send us a postal card.

WATER TREATMENT

Efficient coagulation of surface or well waters. Aids taste and odor control—Effective in lime soda-ash softening. Adaptable to treatment of nearly all industrial waters.

SEWAGE TREATMENT

Ferri-Floc coagulates water and wastes over wide pH ranges—it provides efficient operation regardless of rapid variations of raw sewage and is effective conditioning sludge prior to vacuum filtration or drying on sand beds.

TENNESSEE TC CORPORATION

617-29 Grant Building, Atlanta, Georgia

How a Four-Man Crew laid 1500 feet a day of CLOW Bell-Tite® pipe through Florida swampland

CLOW cast iron pipe, with the sensational Bell-Tite joint, proved its advantages conclusively in this Clearwater, Florida, installation.

That a four-man crew was able to lay this CLOW Bell-Tite pipe at 1500 feet a day under these adverse conditions is definite evidence of the time, labor and money-saving advantages of this CLOW-designed joint. Two men worked in the trench—often in 3 feet of water. One man lubricating and aligning the joints, the other assembling with a pinch bar. A crane operator and a hook-up man completed the crew.

CLOW Bell-Tite forms a pressure-tight joint—instantly—no bolts or follower glands required. Under practically all conditions, it is the fastest, easiest and most economical pipe for water main installation. Underwriters' Laboratories Inc. listed in diameters 3- through 24-inch.

Shows simple assembly of CLOW Bell-Tite joint. Just wipe clean, lubricate and push spigot into the bell. When painted yellow stripe is no longer visible, joint is bottle tight.

Under-water assembly of 8" Bell-Tite pipe at Clearwater, Fla.
Contractor: Hancock Pipe Company, Clearwater, Fla.

JAMES B. CLOW & SONS, Inc.

CLOW 1878 ®

201-299 North Talman Avenue, Chicago 80, Illinois

Subsidiaries:
Eddy Valve Company, Waterford, New York
Iowa Valve Company, Oskaloosa, Iowa

Equipment News

CONTINUED FROM PAGE 21A

built to handle water containing up to 20 per cent solids.

The pump operates either partly or completely submerged. A built-in thermostatic cut-off protects the motor against damage from overheating, obstructions or overloading. A built-in automatic reset restarts the pump when obstructions are removed or overloading is relieved.

The unique submersible motor operates in a factory-sealed oil bath. It is cooled by discharge water. This heavy-duty, squirrel cage, three-phase 60-cycle submersible type motor is rated at 7½ hp.

The single-stage centrifugal type pump has a closed impeller mounted directly on the motor shaft. Specially designed back blades keep foreign matter from the motor seal. A ⅜-in. mesh stainless steel screen protects the pump inlet.

The pump has a capacity of 460 gpm at 15 ft head. With a 70 ft head, the pump will handle 145 gpm.

The unit weighs 238 lb. It can be used for portable service or permanent installations.

Handgun Simplifies Valve Lubrication

313

Rockwell Manufacturing Co., Pittsburgh, Pa. has developed a new high-pressure hydraulic handgun specially designed for plug valve lubrication.

Lighter and more rugged than conventional guns, the new Rockwell "400-C" is self-priming and can be used in any position.

Because of the extra-high pressure this gun exerts, the hose and coupler can be locked to the buttonhead coupler and fitting.

Other protective features include:

CONTINUED ON PAGE 25A

non-slipping power transmission licks tough coral digging

You dig coral rock when you dig in Dade County, Florida. Clevelands have been chewing out trench in these tough rock formations for over 30 years, delivering good steady production on every job. This dependable performance in rugged digging is largely due to Cleveland's time-proved system of economical power transmission to digging-wheel and crawler, through positive, power-saving, non-slipping gear trains. Cleveland's exclusive multi-speed transmission gives the operator finger-tip control of more than 30 usable, closely graduated combinations of digging-wheel and crawler speeds, putting at his command always the *right* combination of digging power and speed for every soil and terrain, for every digging condition.

Send now for Folder V-616 fully describing this valuable Cleveland Trencher advantage.

The CLEVELAND TRENCHER Co.

20100 St. Clair Ave.
Cleveland 17, Ohio

Good Everywhere

AMERICAN *Fastite*** Joint* Pipe ...your best buy!

Exclusive double-sealing, dual-density, heavy-sectioned gasket.
Self-centering beveled spigot and tapered socket for easy assembly.
Flared socket for liberal deflections.
Long life, high strength centrifugal cast iron pipe.
1
2

AMERICAN Fastite Joint pipe combines the century-proven qualities of cast iron pipe with the exclusive time and labor saving features of a new *double-sealing* single gasket type joint. Here is simplicity of assembly: insert gasket . . . lubricate spigot . . . pull pipe together. No calking or further joint work required . . . and it's bottle tight!

Write now for free, illustrated booklet.

*Patent applied for—Underwriters' Laboratories, Inc., approved.

SALES OFFICES

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Orlando • Birmingham

AMERICAN CAST IRON PIPE CO.
BIRMINGHAM 2, ALABAMA

Equipment News

CONTINUED FROM PAGE 23A

(1) A relief fitting on the hydraulic system to guard against injury to the gun if the operator continues to pump after the gun is empty. (2) A Rockwell 15,000-psi gauge indicating the point at which sufficient lubricant pressure has been developed in the valve—signaling this by a sudden drop in pressure reading. The gauge also indicates valve adjustment and other services required—and has a "recalibrator" screw providing positive and easy corrections in case it is knocked out of adjustment by rough handling.

End Suction Pumps

314

Aurora Pump Div., New York Air Brake Co., Aurora, Ill., has developed a line of end suction type BC general purpose pumps in close coupled horizontal, flange mounted vertical, base mounted vertical, and pedestal mounted horizontal units. The range of sizes is from ¼ hp to 40 hp at 3,500 rpm; ¼ hp to 20 hp at 1,750 rpm.

Some of the features claimed for these new pumps are: Low NPSH characteristics to meet critical suction conditions; Standard approved motors; Pumps may be changed from packing to seals by means of interchangeable inserts; Shaft sleeves of bronze, case wearing rings of nickel-iron; Wide gasket seals prevent leakage between casing and mating parts.

Longer Cycle High Water Level Sump Pump

315

Piqua Machine and Manufacturing Co., Piqua, Ohio, has announced that submersible sump pump installations can now be set for longer cycles and higher water levels with the Long Cycling Submersible Sump Pump.

Packaged in a fully assembled unit, the MA Enpo submersible sump pump is equipped with a fully "Unitized" long cycling submersible float switch

CONTINUED ON PAGE 28A

J. Pauli, Chief Engineer and W. Johnson, Chief Chemist of the St. Joseph, (Mo.) Water Company, discuss operation of their W&T V-notch chlorinators. The St. Joseph Water Co. is part of the American Water Works Service Co., Inc. system.

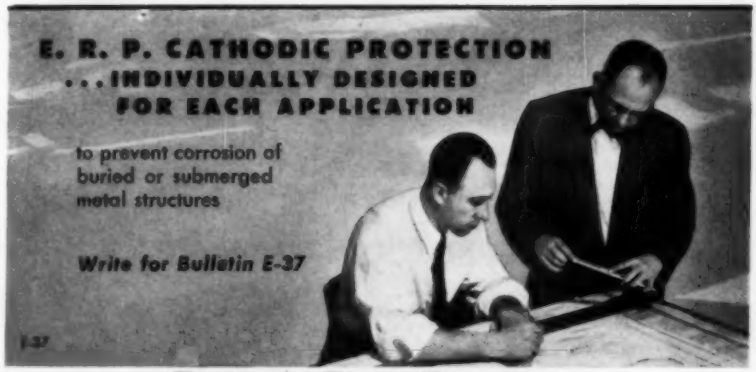
W & T V-notch Chlorinators — doubly accepted

The St. Joseph Water Co. found breakpoint chlorination the best way to treat Missouri River water. But this increased the range of chlorine requirements in the water treatment. W&T V-notch chlorinators were the answer.

W&T V-notch chlorinators have a chlorine feed range of 20 to 1 with an accuracy of 4%. Based on this acceptance at its St. Joseph plant, the American Water Works Service Co., Inc. has purchased V-notch equipment for use in other plants.

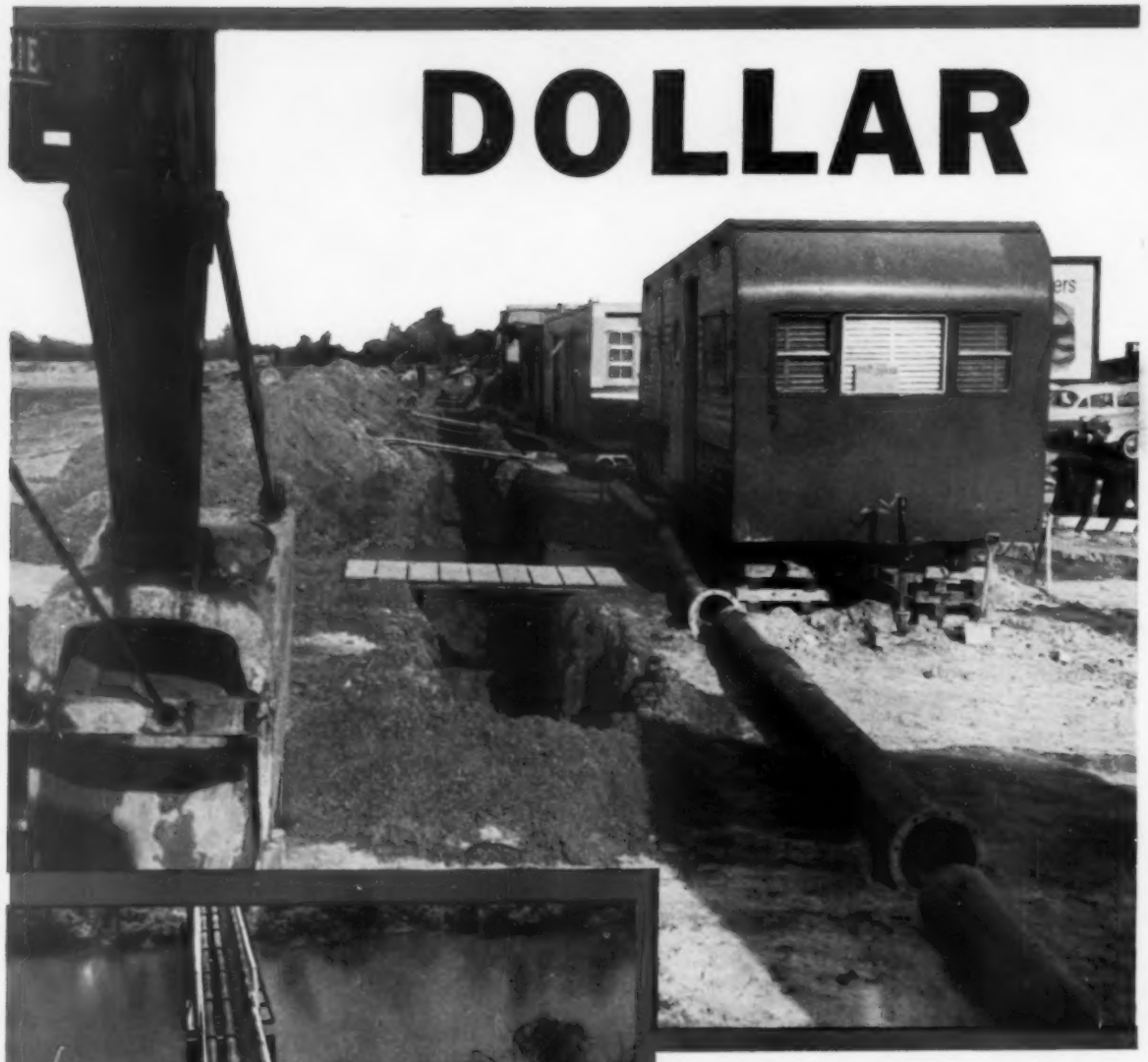
V-notch chlorinators are available to feed from 2½ to 8000 pounds of chlorine per 24 hrs. V-notch equipment also provides permanence and attractiveness through modern reinforced plastics. For comprehensive information about W&T V-notch chlorinators, write for Bulletin S-122.

WALLACE & TIERNAN INCORPORATED
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY


E. R. P. CATHODIC PROTECTION
...INDIVIDUALLY DESIGNED FOR EACH APPLICATION
to prevent corrosion of buried or submerged metal structures
Write for Bulletin E-37
E-37

ELECTRO RUST-PROOFING CORPORATION
30 MAIN STREET, BELLEVILLE 9, N. J.

DOLLAR



Ash disposal line for power plant in Alabama, being constructed with 12" Mechanical Joint Cast Iron Pipe.

Big Business, too, chooses Cast Iron Pipe

Fire protection line for large automotive plant in New Jersey, built with Mechanical Joint Cast Iron Pipe.

MODERNIZED **cast iron**

FOR DOLLAR

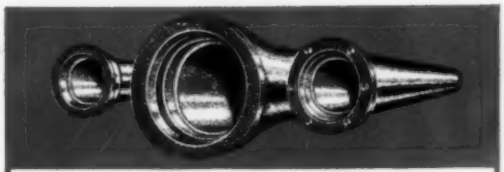
Cast Iron Pipe delivers MORE water...LONGER!

Pipe is a capital investment.

But cast iron pipe is an investment that pays off.

- *In longer life* . . . cast iron pipe serves for centuries.
- *In more efficient operation* . . . cast iron pipe requires little or no maintenance or replacement.
- *In taxpayer satisfaction* . . . cast iron pipe far outlasts the bond issue that paid for it.

Most important to you, these statements are based on proof, not claims . . . performance, not promise. Specify cast iron pipe, America's most dependable pipe, and be sure, not sorry.



6 reasons why Cast Iron Pipe is #1 choice of U. S. A.

1. **HIGH FLOW CAPACITY . . .** Cement lined cast iron pipe and fittings will not tuberculate . . . delivers a full flow for the life of the pipe.
2. **LONG LIFE . . .** 42 North American cities are still using cast iron water mains laid 100 years and more ago. Hundreds more have passed the 50 year mark.
3. **BEAM STRENGTH . . .** Cast Iron Pipe is inherently tough . . . stands up under heavy traffic load, soil displacement and disturbance.
4. **EXTERNAL LOAD RESISTANCE . . .** 6" Class 150 Pipe withstands a crushing load of 17,900 pounds per foot . . . nearly 9 tons.
5. **CORROSION RESISTANCE . . .** Cast Iron Pipe effectively resists corrosion . . . vital factor in its long life and dependability.
6. **TIGHT JOINTS . . .** A full range of leak-proof, low cost, easy-to-assemble joints for pipe and fittings are available for all conditions.

THE MAN WHO CHOOSES CAST IRON PIPE TODAY WON'T PAY FOR IT AGAIN TOMORROW!

CAST IRON

Cast Iron Pipe Research Association
Thos. F. Wolfe, Managing Director
Suite 3440, Prudential Plaza, Chicago 1, Ill.

pipe FOR MODERN WATER WORKS

KUHNS

DUCTILE IRON PIPE FITTINGS*

If your biggest maintenance problem is downtime for replacing fittings, you'll be interested in the money saving advantages of Kuhns Ductile Iron Pipe Fittings.

Their superior corrosion resistance, high strength and ability to withstand shock assure extra years of service, help reduce operating costs and simplify maintenance. Their smooth bore helps eliminate clogging, keeps systems working at maximum efficiency.

Wide Selection With a complete line of cast iron fittings and the newly developed ductile series, Kuhns offers the *right* fitting for practically every purpose. Choose from all types of flanged fittings from 1½" through 12"; companion flanges from 1" through 12"; screwed fittings from ¼" through 12". Over 3000 sizes and shapes, available coated, galvanized or uncoated to meet your specific requirements. Write for full details.

*Kuhns ductile fittings are listed and pressure rated by the Underwriters' Laboratories, Inc. All Kuhns fittings are available nationally through better wholesalers.

THE KUHNS BROTHERS CO.
1800 McCALL STREET • DAYTON, OHIO

1887 • 70 years of continuous progress • 1957

Equipment News

CONTINUED FROM PAGE 25A

already mounted and adjusted on the discharge line. The pump performs best with full 1¼ inch line and in sumps at least 16 inches in diameter.

Both the "Enpo" MA pump and the RSC switch are fully sealed to prevent rust or flooding. The unit is encased in rugged armor to resist damage and is permanently lubricated. The "Enpo" motor has a built-in automatic reset thermal protector and will operate in water as hot as 200-degree F. It will withstand a limited exposure to steam.

Open impellers are used on standard Enpo models to carry light debris and heavier semisolids without screening while enclosed impellers are used on High Head models which do require Piqua's CS-1 mesh screen. Four standard models are available to handle any industrial or domestic installation.

New Use For Sewer Cleaning Tool

316

Flexible Inc., Los Angeles, Calif., has reported that many sewer departments have found that the Flexible Porcupine "cleans sewers fast",

where the deposits are light.

Originally developed as a "finishing tool", the Porcupine when turned on a string of rods can often restore normal flow to sewers. Bucket machines are of course, necessary for removing medium and heavy deposits.

In using the Porcupine for this purpose, it is necessary to "work with the flow" for moving sand or silt. In this case a head of water is built up which jets through the bristles and washes the deposits down the line as they are churned up by the tool. The Porcupine is also an excellent tool to get lacy overhanging roots missed by corkscrews and augers.

CONTINUED ON PAGE 96A

New Bulletins *AVAILABLE FREE*

Handling Slip-Joint Clay Pipe

317

Clay Sewer pipe Assn., Inc., Columbus, Ohio, has just published a new two-page bulletin, "Handling, Storing, Installing Slip-Joint Clay Pipe", another in a series of technical bulletins.

This bulletin illustrates and describes the approved methods for handling, storing, and installing clay pipe with pre-cast factory-made bituminous joints including suggestions on preparing trenches.

Centrifugal Pumps

318

Ingersoll-Rand, New York, N. Y. has just published a bulletin describing Ingersoll-Rand's centrifugal pumps designed for continuous heavy-duty operation within the medium pressure range.

The bulletin includes cross-sectional views and a complete table of pump dimensions.

According to the bulletin these pumps are horizontally-split, single suction pumps built with 3, 4, 6 or 8 stages for capacities from 200 to 2800 gallons per minute. Pressures go up to 1200 psi and heads range between 460 and 2400 feet. Any conventional type of driver can be used with the RT pumps and the customer may choose between ball bearings and sleeve bearings for his units.

Rotary Compressors

319

Kellogg Division, American Brake Shoe Co., New York, N. Y. has just published a brochure on new rotary air compressors.

Smaller and lighter than reciprocating compressors of equivalent output, these 1-2 hp pumps supply air in the 150-175 psi range.

The eight-page, two color folder explains principle of operation with cutaway diagrams, describes special features, and details operating and mounting specifications.

Flocculation Equipment

320

Chain Belt Co., Milwaukee, Wis., has just published a new bulletin on Rex Flocculation equipment.

The new Chain Belt bulletin outlines the flocculation process, illustrates the wide selection and application of flocculation equipment; and gives technical details of Rex Flocculators.

pH Equipment

321

Beckman Process Instruments Division, Fullerton, Calif., has announced the availability of a new eight-page brochure, "Beckman Industrial pH Equipment".

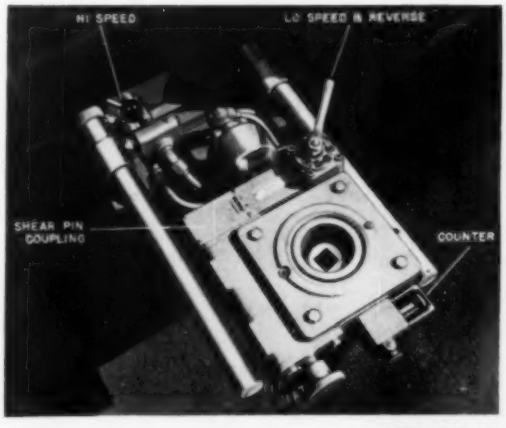
The bulletin gives detailed descriptions and specifications for all Beckman industrial pH instruments, electrodes and accessories. Continuous pH measurement is used in the control of chemical, petro-chemical, food, metals, beverage, water, sewage, pharmaceutical, and pulp and paper processes.

The brochure is profusely illustrated with photographs and detailed drawings.

CONTINUED ON PAGE 30A

PAYNE DEAN VALVE OPERATOR
NEW—FLUID DRIVE

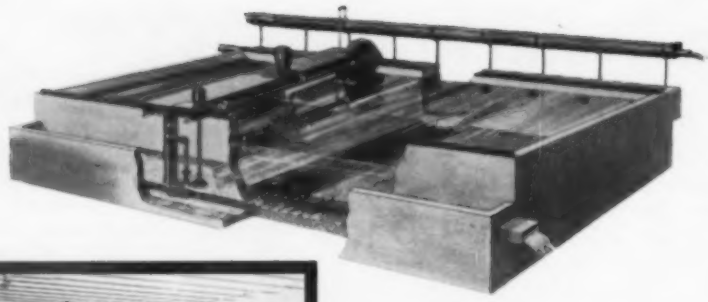
NO SHAFTS—ALL HYDRAULIC

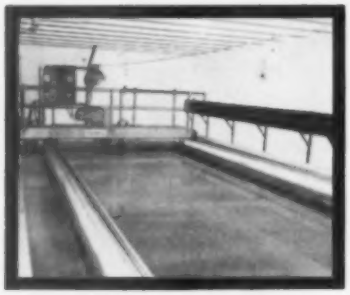


CENTRALIZED CONTROL

Makes Every Valve Power Operated

PAYNE DEAN & CO., CLINTON, CONN.





12½′ x 40′ Hardinge Automatic Backwash Sand Filter in a municipal water plant in Vermont.

12½′ x 86′ Hardinge Filter handling water supply for a Canadian paper plant.

A sand filter which

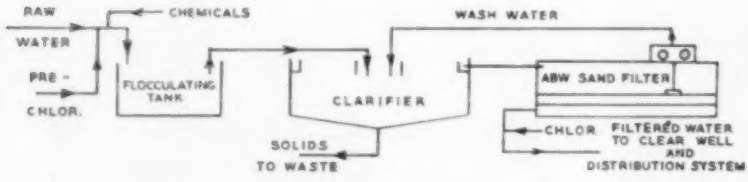
CLEANS ITSELF

The Hardinge Automatic Backwash Sand Filter is a complete departure from standard filtration equipment, in that it backwashes its filter bed automatically without interrupting normal filtration.

The ABW filter in combination with flocculation and sedimentation equipment provides treated and filtered water for municipal and industrial water supplies.

The filter may be applied also for the treating of plant waste water, for reuse or disposal.

Complete specifications upon request. Bulletin 46–A–15



The flow sheet above illustrates the use of a Hardinge ABW Filter, in conjunction with Hardinge flocculating and clarifying equipment, on municipal or industrial water treatment. A modified system is available for liquid waste disposal or reclamation.

HARDINGE
COMPANY, INCORPORATED

YORK, PENNSYLVANIA • 240 Arch St. • Main Office and Works

New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco

New Bulletins

CONTINUED FROM PAGE 29A

Weather Protected Motor

322

Allis-Chalmers, Milwaukee, Wis., just published a bulletin presenting the features which contribute to the outdoor dependability of A-C weather protected motors (Type FOD) built to NEMA and ASA standards in sizes NEMA frame 505 through 800 hp at 3600 rpm.

According to the bulletin the motors feature a sturdy steel frame, a removable prewound stator, assembly, proven insulation, capsule-mounted split sleeve bearings, removable air ducts, and protective screens.

Axial Compressor

323

Allis-Chalmers, Milwaukee, Wis., has released a bulletin describing the design and construction features of Allis-Chalmers axial compressors available in sizes from 8,000 to 1,000,000 cfm.

Among the advantages cited in the bulletin for the axial compressor is its basically constant volume with variable pressure output; high efficiency, compact, streamlined design; flexibility, and virtually trouble-free operation.

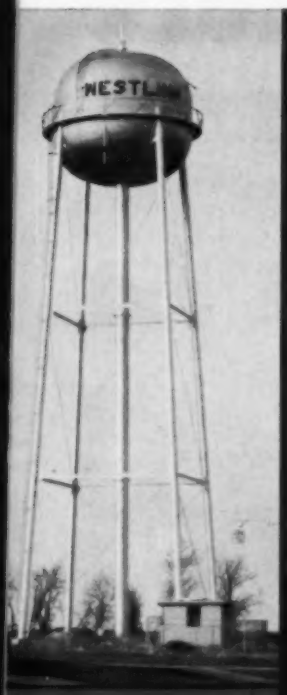
Blower-Compressor

324

Cyclo Blower Co., York, Pa., has just released a four page, 2-color, letterhead-size bulletin announcing the "CycloBlower", an axial-flow, positive-displacement blower for compression and vacuum service in a range from 85 to 3,342 cubic feet per minute. Bulletin includes table of engineering data for eight models and performance curves for three models. The curves show brake horsepower and capacities in cfm for selected speeds and sic pressures; namely, 3, 5, 7, 10, 12 and 15 pounds per square inch, gauge. Table gives speed range and dimensions of each model as well as cfm and brake hp at pressures of 5, 10 and 15 psig.

CONTINUED ON PAGE 100A

KANSAS

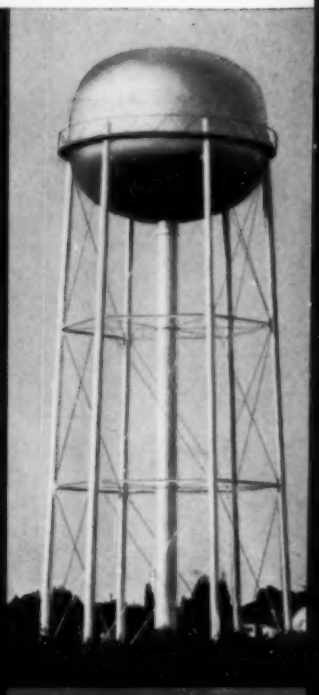


WICHITA
100,000 Gallons
Head Range 21'01"

OLATHE
250,000 Gallons
Head Range 30'10½"

WISCONSIN

RACINE
150,000 Gallons
Head Range 24'9¾"



NEENAH
300,000 Gallons
Head Range 30'09"

Some recent examples of Double Ellipsoidal in the very low head-range range

PDM
ELEVATED STEEL TANKS

The low range of head inherent in all PDM Double Ellipsoidal Elevated Steel Tanks is an advantage emphasized particularly in the capacities from 100,000 to 300,000 gallons.

• As illustrated in the installations above, you get low head range *plus* fine appearance in our Double Ellipsoidal design. Let us detail for you the important *economy* factors, as well.

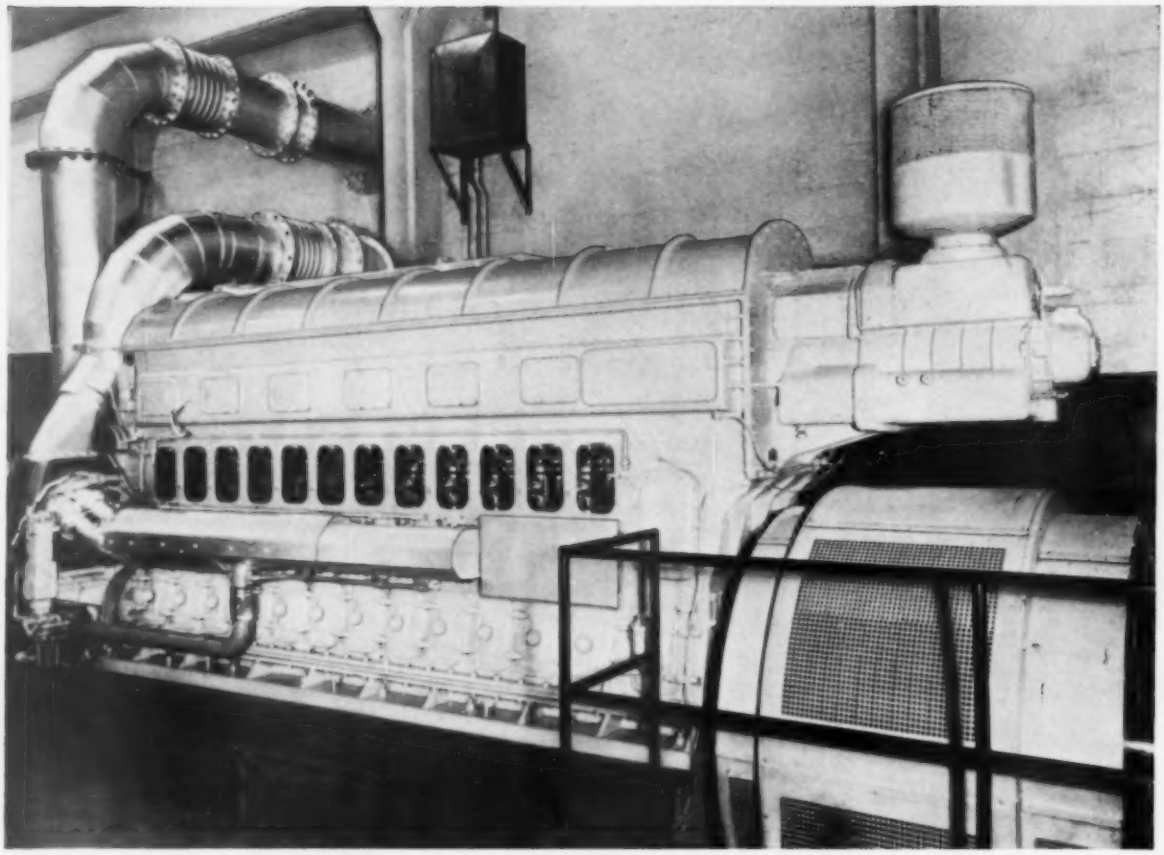
Pittsburgh-Des Moines Steel Company

Plants at PITTSBURGH, DES MOINES, SANTA CLARA, FRESNO, and CADIZ, SPAIN

SALES OFFICES AT:

PITTSBURGH (25) .....3418 Neville Island
NEWARK (2).....1718 Military Park Bldg.
CHICAGO (3)..622 First National Bank Bldg.
EL MONTE, CAL.....P. O. Box 2012
ATLANTA (5)..361 E. Paces Ferry Rd., N.E.
DES MOINES (8).....919 Tuttle Street
DALLAS (1).....1223 Praetorian Bldg.
SEATTLE (1).....Suite 326, 500 Wall St.
SANTA CLARA, CAL.....625 Alviso Road
DENVER (2).....323 Railway Exchange Bldg.

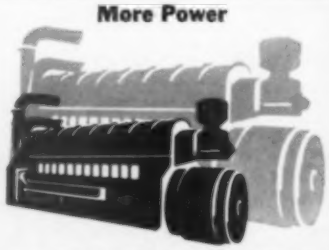
NOW Fairbanks-Morse
TURBOCHARGED



Now from Fairbanks-Morse comes the year's most significant power news: the Opposed-Piston diesel is turbo-supercharged!

Backed by 20,000 hours of actual operation and research, this new, yet proved, design increases O-P horsepower by 50%. At 900 rpm., for example, the turbocharged O-P is conservatively rated at 300 hp. per cylinder. Combining simple, two-cycle Opposed-Piston design of engine with new Fairbanks-Morse-designed system of turbocharging produces compact, reliable power with low operating and maintenance costs. None of the basic O-P advantages have been eliminated. In fact, many parts are interchangeable between turbocharged and non-turbocharged Opposed-Piston engine models.

More Power



The un-turbocharged O-P is the industry's leader in compact power . . . now 50% more power can be placed in the same installation with the same size turbocharged O-P.

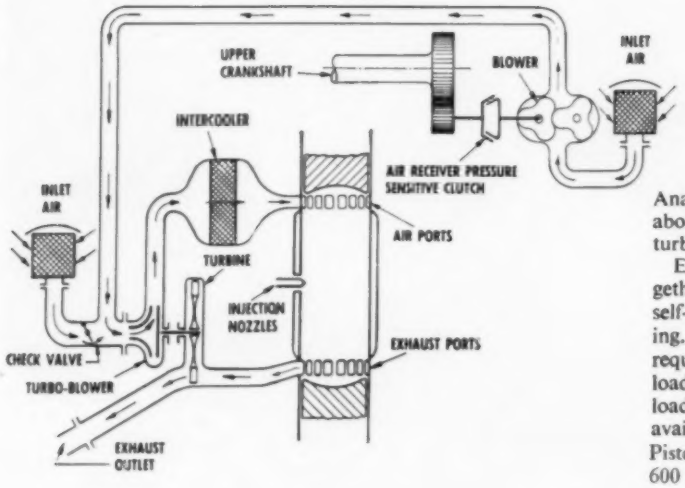
Lower Weight

—per horsepower. Increased O-P power is more widely applicable where weight and foundation costs are restrictive. Weight per horsepower has been reduced by 27%.

Increased Thermal Efficiency

The new, performance-proved thermal efficiency of the turbocharged Fairbanks-Morse Model 38TD-8⅛ O-P diesel is knocking on the door of a new high of 40% efficiency.

OPPOSED-PISTON DIESEL
50% MORE POWER
for Marine and Stationary Applications



Matched Engine and Turbocharging

Analysis of many turbocharging options established the above arrangement for optimum performance of the turbocharged Opposed-Piston diesel.

Exact matching of O-P engine and this system, together with manifold design, results in an engine that is self-sustaining over the entire load range, including starting. The small engine-driven auxiliary blower meets the requirements of sudden, large load changes at fractional loads only—and is automatically declutched above ⅓ load. Power formerly used for blower drive is therefore available at the flywheel of the turbocharged Opposed-Piston Diesel. Fairbanks, Morse & Co., Dept. WSW-3, 600 S. Michigan Ave., Chicago 5, Ill.

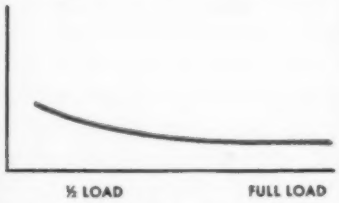
FAIRBANKS-MORSE
a name worth remembering when you want the BEST

DIESEL AND DUAL FUEL ENGINES • DIESEL LOCOMOTIVES • RAIL CARS • ELECTRICAL MACHINERY • PUMPS • SCALES • HOME WATER SERVICE EQUIPMENT • MAGNETOS

Pulse System

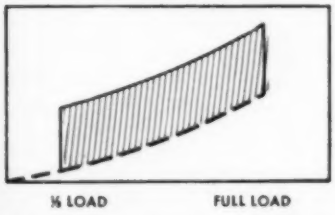
F-M exhaust manifolding carries peak pulse energy directly to the turbine drive, thus taking full advantage of additional driving force available in these exhaust pulses.

Lower Fuel Consumption



For full-load operations, specific fuel consumption of the turbocharged O-P is 5% to 10% lower than un-turbocharged O-P—and very much lower for part loads.

Bonus Power



At loads above approximately ½ rating, the auxiliary blower is automatically declutched, thus making additional, usable power available at the flywheel.

ARE YOU UP-TO-DATE ON FLOCCULATORS?

THIS NEW BOOKLET HAS THE FACTS!

If you're interested in flocculation equipment...for water, sewage or industrial waste treatment...you need this new fact-packed Bulletin No. 315-51. It describes the Rex line of flocculating equipment to suit all conditions...where there are *no* floating solids...where there *are* floating solids...and for parallel or cross flow arrangements.

Bulletin 315-51 gives you the complete story on Rex Floctrol...Slo-Mixer... Cross-Flow Flocculator...Vertical Flocculator...and Flash-Mixer. It clearly shows the advantages of Rex tank designs, and of Rex equipment to help you improve mixing, save chemicals, and increase plant efficiency.

Send for your copy today. Write to your Rex Sales Engineer, or to CHAIN Belt Company, 4610 W. Greenfield Ave., Milwaukee 1, Wis.

CHAIN BELT

American Frost Bottom Meter has frost separable gear train and chamber.

METER DEPARTMENT REPAIRMAN

TROUBLE-SHOOTER, SKILLED METER CRAFTSMAN

He says, "I like American Meters because they are so easy to repair. I only need to replace the parts that are worn — no expensive unit assemblies."

Yes, you can take an American Meter apart and reassemble it in less time — this means a lower labor cost for a given repair. And there are not so many parts to replace in a given job — lower parts cost. And finally, you can't put an American Meter together wrong — no lost time.

The smart repairman keeps his department free of obsolete meters by recommending the purchase of American Meters.

BUFFALO METER CO.

2909 Main Street • Buffalo 14, New York

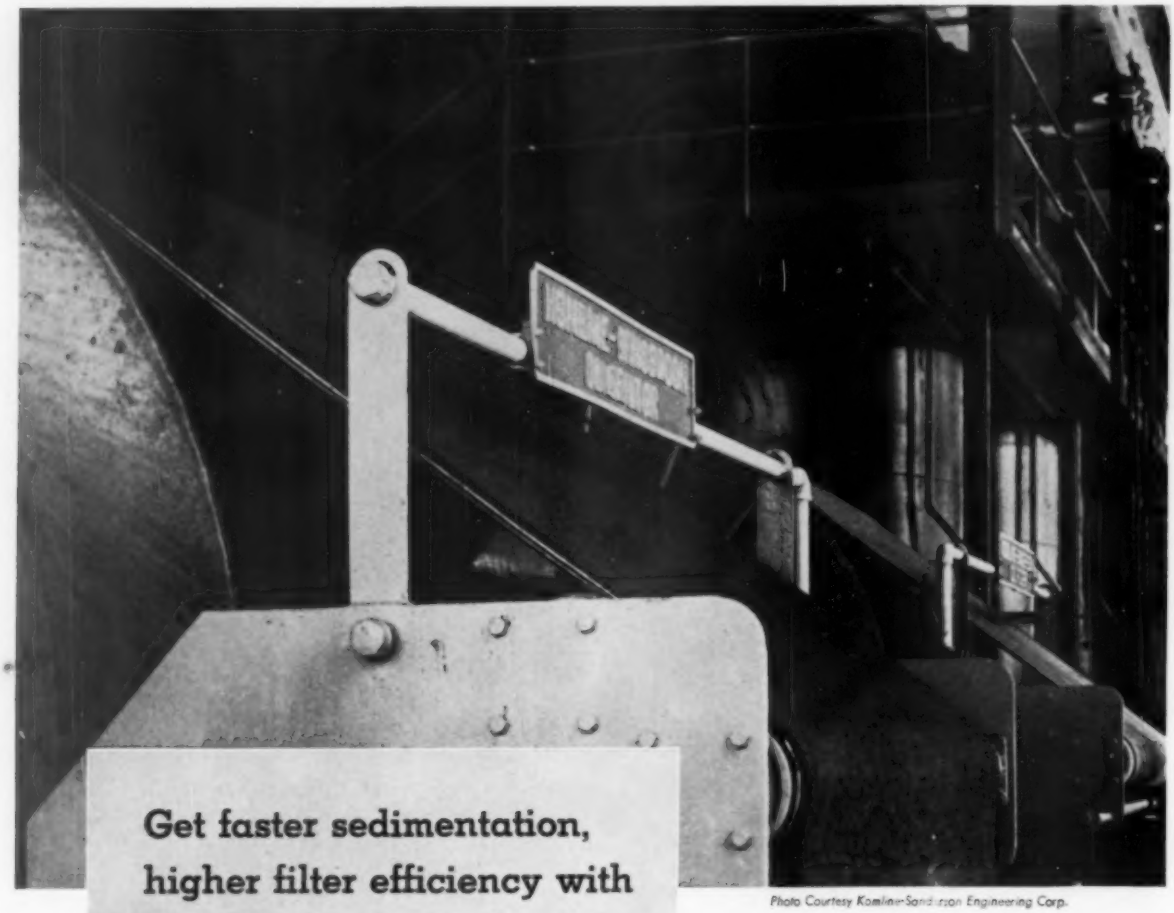


Photo Courtesy Komline-Sanderson Engineering Corp.

Get faster sedimentation, higher filter efficiency with

PENNSALT FERRIC CHLORIDE

Treating sludge with Pennsalt Ferric Chloride pays off in fast sedimentation, superior coagulation. You get thorough precipitation of fresh or digested sludge, regardless of composition . . . plus a drier, denser cake that gives you higher capacity per square foot of filter area.

Anhydrous $FeCl_3$ gives you added advantages of lower transportation cost per unit of active ingredient, and more convenient storage. It is available in non-returnable steel drums of 135 and 350 lbs. Liquid $FeCl_3$ is available in tank cars.

Ask for your copy of Pennsalt Bulletin H-565 on Anhydrous Ferric Chloride. It contains useful data on water, sludge and sewage treating, in handy form.

Quality chemicals for water purification and sewage disposal plants are a specialty at Pennsalt. Other chemicals include Pennsalt Water Works Grade chlorine and ammonia. In addition, Pennsalt technical and purchasing assistance helps you buy, store, and apply these chemicals economically. Call or write today for full information.

See our Catalog in CMC

INDUSTRIAL DIVISION
PENNSALT CHEMICALS CORPORATION
3 Penn Center, Philadelphia 2, Pa.
Regional Offices:
Chicago • Detroit • New York • Philadelphia • Pittsburgh • St. Louis
District Offices: Appleton • Cincinnati • Atlanta
Representatives: Airco Company International, New York
Pennsalt Chemicals of Canada Ltd., Oakville, Ontario

Pennsalt Chemicals ®
ESTABLISHED 1850

In the West, Pennsalt inorganic chemicals are available through Pennsalt of Washington Division, with plants at Tacoma, Washington and Portland, Oregon.

"Our Crew Laid Over 200 Feet of 54" I.D. Cen-Vi-Ro Bell and Spigot Sewer Pipe the First Working Day!"

It's easy to install Cen-Vi-Ro Concrete Pipe

Here's Proof! A crew from Harbert Construction Corporation, Birmingham contractor, in its first experience with Cen-Vi-Ro Bell & Spigot rubber gasket Sewer Pipe, laid over two hundred feet of 54" diameter pipe the first eight-hour working day!

J. W. Goodwin Engineering Company, Birmingham, Alabama, were engineers on this job. It called for 630 feet of Cen-Vi-Ro Concrete Sewer Pipe, Teckote lined, as part of the Jefferson County Sewage Trunk Line, under the expanding Birmingham CAA Municipal Airport.

Cen-Vi-Ro Bell & Spigot Pipe with rubber gaskets is available in 12" to 54" diameters. Cen-Vi-Ro Concrete Pipe's longer, faster-laying lengths, easier, faster handling and fewer joints mean extra stability and lower labor costs.

Write today for the complete story on the many other advantages of Cen-Vi-Ro Concrete Pipe.

THE NAME ITSELF MEANS THE WORLD'S FINEST CONCRETE PIPE!

CEN-VI-RO

Comes from **Centrifugally** spinning dry, "earth-moist" mixture fed into form in uniform layers.

comes from **Vibration** of spinning form during charging. Special vibrator-tampers do this job.

comes from **Rolling** mixture under great pressure, applied by specially designed steel roller.

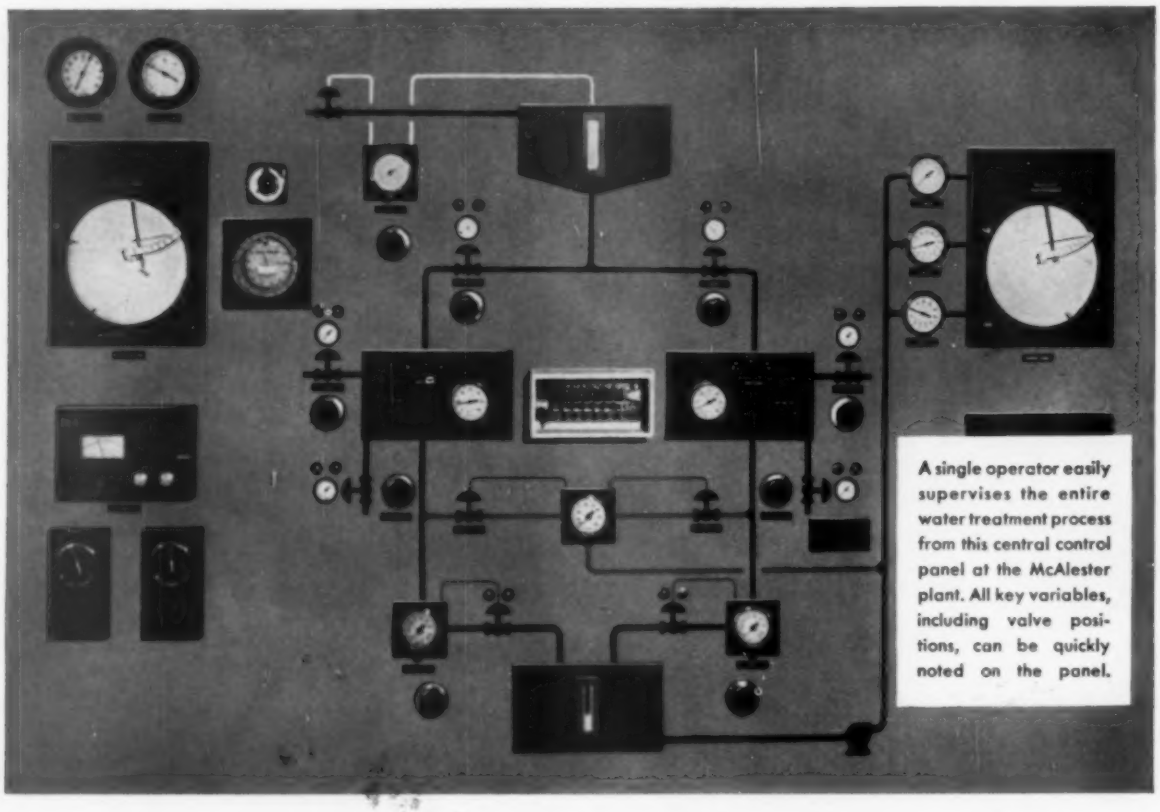
Vulcan Materials Company

"Organized for Service"

A Subsidiary of the Vulcan Materials Company

Southern CEN-VI-RO PIPE CORPORATION

Post Office Drawer 155 • Birmingham, Alabama



A single operator easily supervises the entire water treatment process from this central control panel at the McAlester plant. All key variables, including valve positions, can be quickly noted on the panel.

Honeywell *FiltermatiC** system brings

HIGH-RATE, LOW-COST OPERATION

to water plant in McAlester, Oklahoma

With its new Honeywell *FiltermatiC* control system, the recently modernized and expanded water treatment plant at McAlester, Oklahoma, is completely automatic. Control is centralized at the graphic panel shown above, so that one operator can supervise the entire process. The plant supplies 10 mgd to McAlester's 22,000 residents, with treatment rate balanced precisely with demand.

Supply is automatically regulated by three separate but interrelated control loops. One loop controls flow rate from the filters to the clear well, using a cascade system in which level changes at the clear well adjust the set point of each effluent controller. The second loop controls water flow to the filters to maintain a constant level. The third loop controls flow rate from the raw water intake to the clarifier, in accordance with changes in clarifier level.

Treatment chemicals are automatically added in correct amounts through use of a *Differential Converter* which measures raw water flow to the mixing basin, and activates flow accumulators, timers and converters. Dials on the graphic panel indicate any loss of head across each filter, and if head loss exceeds six feet, an alarm sounds. The operator then simply presses a button to start a timer that automatically sequences the entire backwashing cycle.

You can gain the many advantages of Honeywell instrumentation in your own plant. Your nearby Honeywell field engineer will be glad to discuss your needs with you and your Consulting Engineer. Call him today . . . he's as near as your phone.

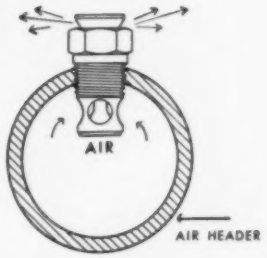
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Products Group*, Brown Instruments, Wayne and Windrim Avenues, Philadelphia 44, Pa.

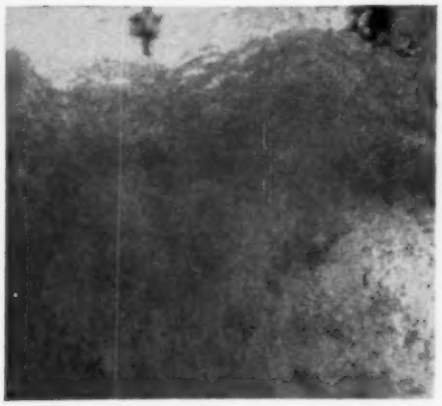
**A Tradename of Minneapolis-Honeywell Regulator Co.*

Honeywell

First in Controls

P.F.T. NEW DEVELOPMENTS IN SEWAGE TREATMENT





New, low cost P.F.T. valved-orifice achieves wide air dispersal and relatively small bubble size.

Low cost, trouble-free air for aeration tanks with new, non-clogging valved-orifice

Now there is a simple, trouble-free way to introduce low cost, low loss air into aeration systems.

Many engineers have found that the new P.F.T. valved-orifice—originally designed for use in the Kraus Dual Aeration System—operates efficiently in numerous other applications, including those where ordinary diffusers would get plugged up. The unique P.F.T. orifice seats automatically when air pressure is turned off, keeping aeration piping and the rest of the system free from contamination. The compressed air need not be cleaned, unlike air used with finer diffusing media.

Actual plant tests of orifice-type air diffusers indicate that the new P.F.T. device requires the least power and makes most efficient use of tank capacity. P.F.T. makes this small, inexpensive orifice of corrosion-proof stainless steel. In addition, P.F.T. supplies specialized piping. valves and supports for a complete aeration system. Write today for additional information.

waste treatment equipment exclusively since 1893

P.F.T.

PACIFIC FLUSH TANK CO.
4241 Ravenswood Avenue
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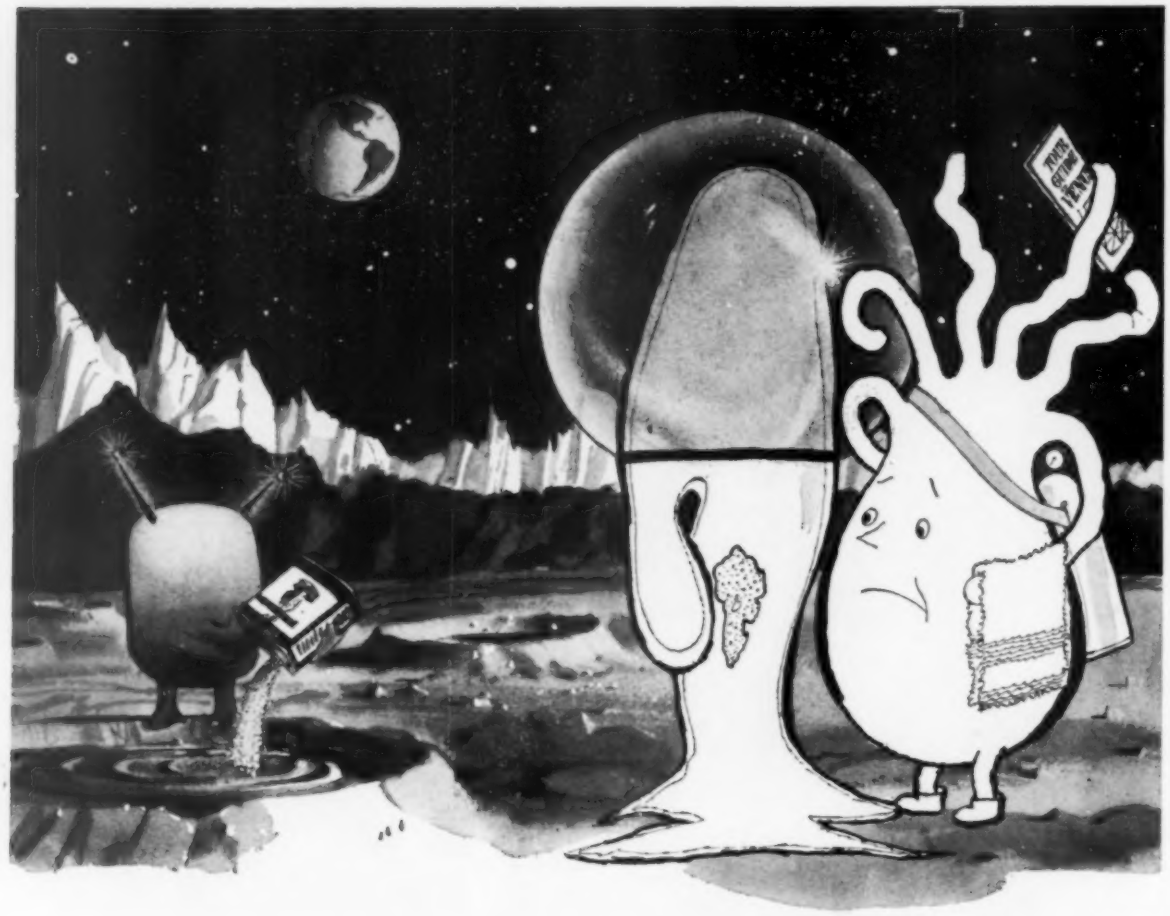
PORT CHESTER, N. Y. • SAN MATEO, CALIF. • CHARLOTTE, N. C. • JACKSONVILLE • DENVER



"The word sure gets around, Algie...

Everybody's using PITTCHLOR®!"

Let's face it, fellows! You unwanted microorganisms might just as well have stayed on Earth. The good news about Pittchlor's lethal effect on chlorine-susceptible bacteria and algae has spread to—well, practically everywhere you two could make nuisances of yourselves.

Water works and sewage engineers everywhere are turning to Pittchlor for sure, economical hypochlorination. Designed as an effective and quick chlorinating agent, Pittchlor is a high test calcium hypochlorite containing a minimum of 70% available chlorine. Its exceptional stability allows its chlorine content to be released over prolonged periods of time. This versatile Columbia-Southern product is also useful where floc formation or deodorizing problems exist.

And easy to use? Dry, free-flowing granular Pittchlor can be applied either by automatic feeders or manually. What could be easier? For more information, send today for free folder.

PITTCHLOR available in 2½ lb. (9 per case) and 5 lb. (6 per case) resealable cans —and 100 lb. drums

Stocked by leading jobbers everywhere

COLUMBIA-SOUTHERN CHEMICAL CORPORATION
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IN CANADA: Standard Chemical Limited and its Commercial Chemicals Division

What good is a meter if you can't read it?

DIRTY FACE

Condensation and dirt cloud the dial on this conventional register.

CLEAN FACE

Rockwell hermetically sealed register always presents a "clean face" to the meter reader.

YOU CAN ALWAYS READ A ROCKWELL SEALED REGISTER WATER METER

In recent years water utilities have spent thousands for oil enclosures, wipers and similar gadgets to lick the problem of fogged registers. Now, for not a penny extra, Rockwell offers a revolutionary new meter having a hermetically sealed register which completely eliminates condensation under the glass.

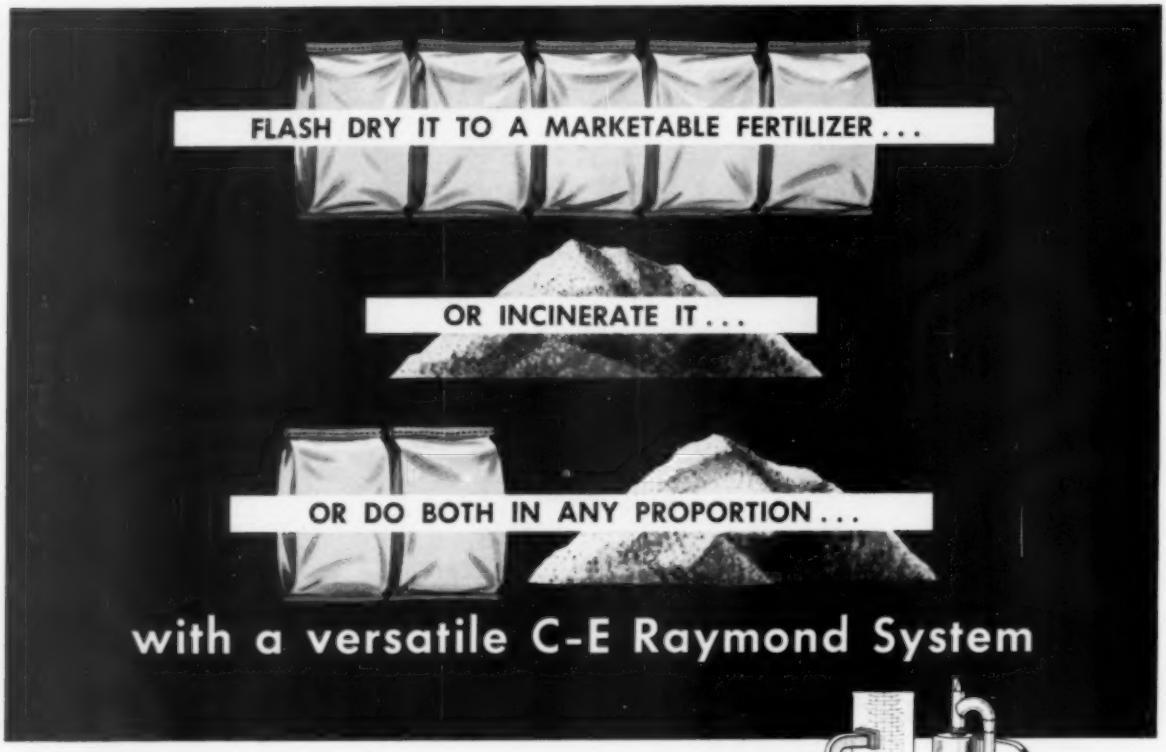
In the Rockwell Sealed Register meter all gearing, including the intermediate train, is encased in a sealed compartment high and dry above the measuring chamber. There's no stuffing box to leak or bind. A powerful magnetic coupling transmits motion smoothly and with the least possible friction. All this means less wear, less chance for corrosive attack, and, of course, easier maintenance at lower cost. Get full facts now, *write to Rockwell Manufacturing Company, Pittsburgh 8, Pa.*

SEALED REGISTER METERS

another fine product by

ROCKWELL

Dispose of Sewage Sludge the Modern Way

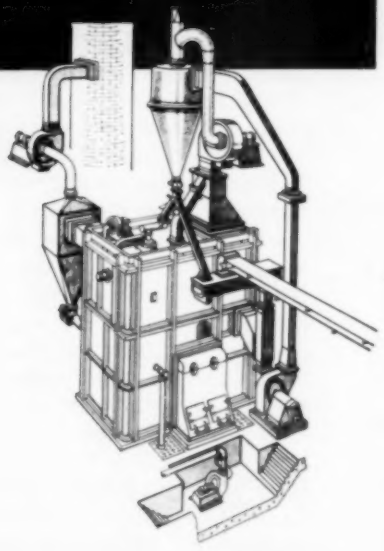


The widespread acceptance of the C-E Raymond System is based on its solid advantages. This compact system combines the principles of Flash Drying and Incineration in a unit in which filter cake can be reduced to a sterile ash . . . or flash-dried to a salable fertilizer and soil conditioner. Revenue from the latter is often sufficient to pay a substantial part of plant operating costs.

Either operation can be performed alone, or combined in any desired proportion. Effective high-temperature deodorization of stack gases is available for both processes.

A C-E Raymond System can mean an end to your community's sludge disposal problems . . . as it has in municipalities across the nation. Contact the Combustion office nearest you for specific recommendations. A C-E specialist will be glad to discuss your requirements and help plan an installation with you or your consultants.

8-998



COMBUSTION ENGINEERING

RAYMOND DIVISION, 1315 North Branch Street, Chicago 22, Illinois

Eastern Office: 200 Madison Avenue, New York 16, N. Y. • Western Office: 510 West Sixth Street, Los Angeles 14, Cal.

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ALSO FLASH DRYING AND INCINERATION SYSTEMS FOR INDUSTRIAL WASTE DISPOSAL

ARE YOU FLOWING YOUR MONEY AWAY?

Reduce Plant Operating Costs with Builders "Bubble-Tight" Butterfly Valves!

Flowing water represents money . . . your money, your client's money, or the community's money! Protect your investment by investigating these operating economies of Builders Butterfly Valves.

BUILDERS AWWA BUTTERFLY VALVES *prevent* . . .

- **Loss of valuable water through faulty seating.**
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"Bubble-Tight" Butterfly Valves backed by Builders specialized knowledge of water and sewage works metering and control problems, offer many exclusive design features which can save you money. Request Bulletin 650-L1B for money-in-your-pocket details.

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B-I-F INDUSTRIES METERS FEEDERS CONTROLS

It takes just two steps to assemble the FLUID-TITE Coupling. Lubricate the tapered edge of the gasket. Then slide in the pipe.

Major Advance In Waterworks Industry. K&M's exclusive FLUID-TITE Coupling provides permanent, water-tight, root-tight connections. Allows deflection of up to 5°. Assembled in any weather.

SLIDE IT IN QUICK... IN 2 EASY STEPS

IT'S "K&M" ASBESTOS-CEMENT PRESSURE PIPE WITH EASY-TO-INSTALL FLUID-TITE COUPLING

Installation is fast and economical! It doesn't require skilled labor, heavy machinery, or heavyweight coupling pullers. Install it in any weather.

The seal grows tighter as the pressure climbs! Coupling rings expand as water mains fill. Rings have holes on one side for self-energizing action.

It's practically indestructible! "K&M" Asbestos-Cement Pressure Pipe is non-tuberculating, non-electrolytic, and corrosion-resistant. Its first cost is often the last cost. Pressure remains normal—pumping costs stay low.

Write today for more information.

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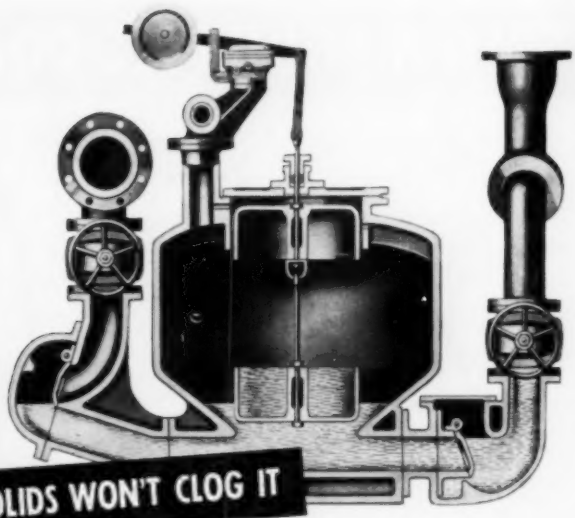
BEST IN ASBESTOS

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

NO MORE PUMP MAINTENANCE!



SOLIDS WON'T CLOG IT

Never Wears Out

This Shone ejector has been in operation for 68 trouble-free years —in the Auditorium Hotel (Roosevelt College), Chicago, Illinois.

- **No Rotating Pump Parts**
- **No Airtight Floats**
- **No High-Speed Shafts or Bearings**

Yeomans makes both pneumatic ejectors and centrifugal pumps. But for jobs from 30 to 600 g.p.m. where you need *extreme* dependability, we'll recommend a pneumatic ejector most of the time. In the long run, it's the economical choice.

Because pneumatic ejectors are clogproof and unusually simple in design, maintenance costs run 50-75% less than for the best centrifugal pump. The smallest Yeomans ejector, for example, will pass four-inch solids. And for pumping domestic and industrial wastes, pneumatic ejectors are safer, more sanitary because they are hermetically sealed.

There are seven models in over 100 sizes to choose from. All operate on compressed air with mechanical or electrical controls that are "Yeomans" foolproof. Use the coupon below to get complete information. Also see Sweet's Catalog, Architectural File.

YEOMANS PNEUMATIC EJECTORS

Manufacturers of pumps for: drainage • sewage • condensation return • water supply and circulation • also equipment for treatment of domestic and industrial wastes.

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Please send me literature on the pneumatic ejectors I have checked.

☐ The Shone® ☐ The Packex® ☐ The Expelsor®

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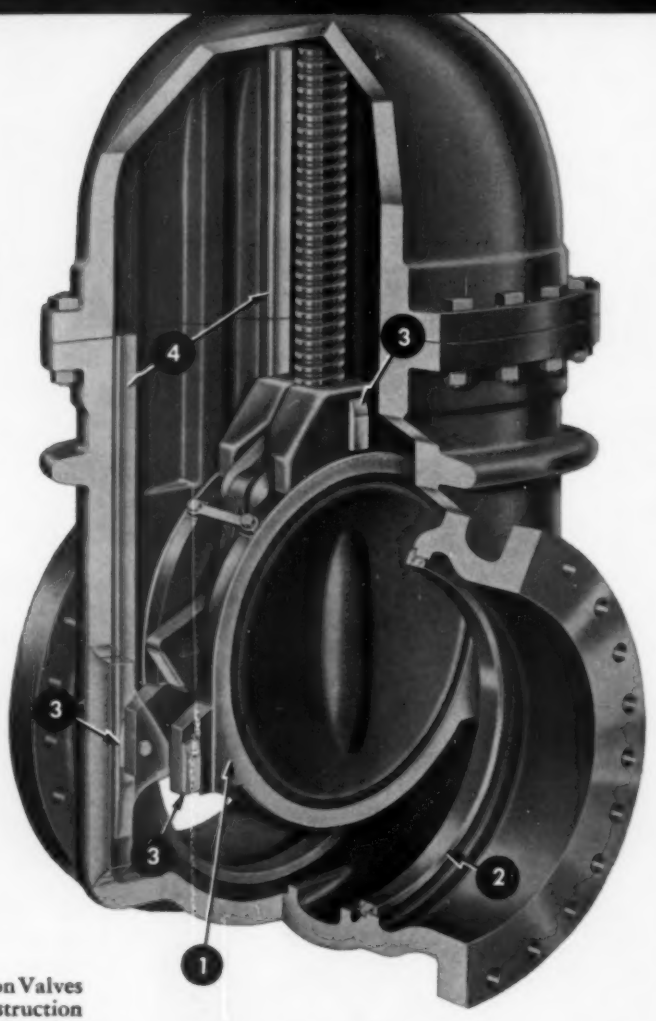
SMITH THROTTLE CONSTRUCTION VALVES

ELIMINATES
disc tilting and chatter

REDUCES
wear of disc & seat ring faces



Smith Square Bottom Throttle Construction Valves have all of the time-proven design and construction refinements of standard Smith Gate and Tapping Valves and are recommended for severe service applications such as throttling in a partly open position, daily or frequent operation against high unbalanced pressure, high velocity or installation in a flat position in vertical piping.

The design features consisting of disc shoes and body tracks mechanically lift and hold the disc ring face (1) out of contact with the seat ring face (2) at all points of disc travel with the exception of the fully closed position.

Throttle construction valve discs are provided with three non-ferrous metal shoes (3), precision-machined and jig located. Valve bodies are provided with three non-ferrous metal machined tracks (4). The three disc shoes register with the three body tracks and each shoe is in contact with a track while the valve is unseated and in any partially open position. The bottom section of each track is bevelled to insure that the shoes will not bear on the tracks when the valve is fully closed.

This construction prevents damage to and uneven disc and seat face wear and assures long service life under severe operating conditions.

Single throttle construction is used when the flow is not subject to reversal. Double throttle construction when the flow is subject to reversal.

57

FIRE HYDRANTS · VALVES · SINCE 1896

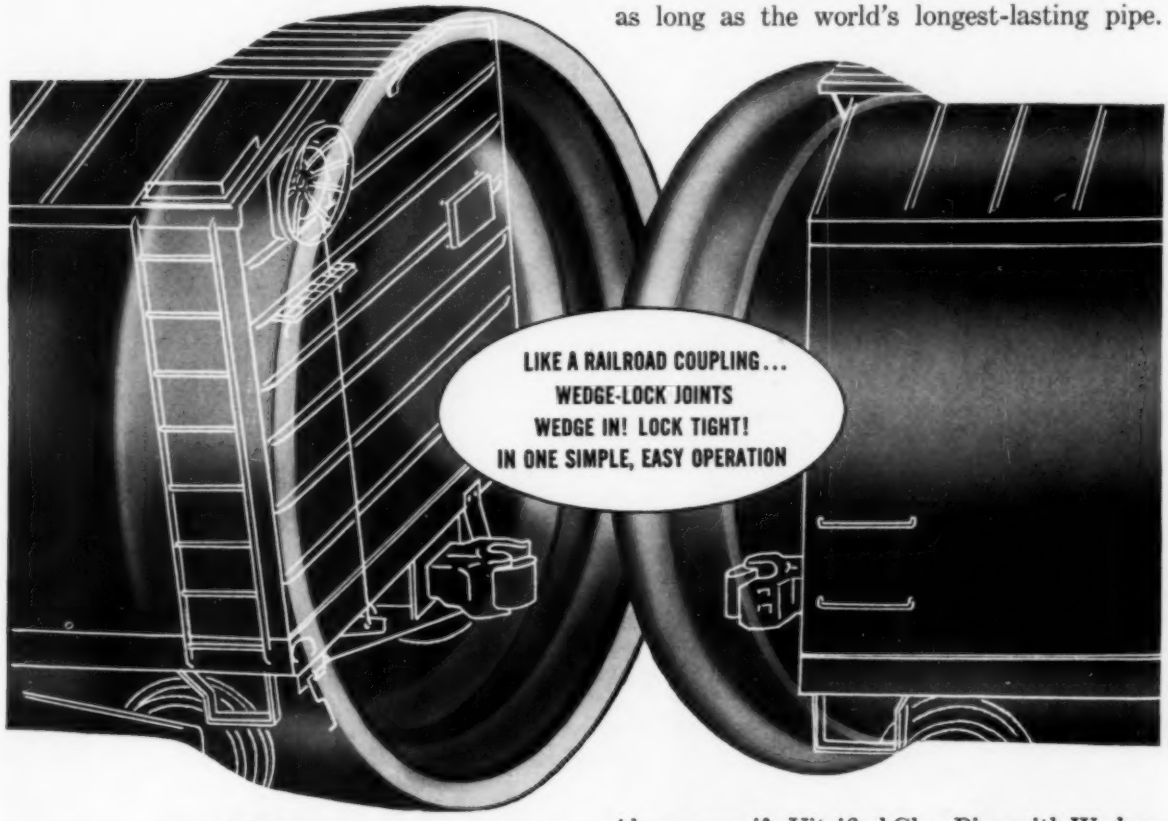
THE A.P. SMITH MFG. CO.
EAST ORANGE, NEW JERSEY

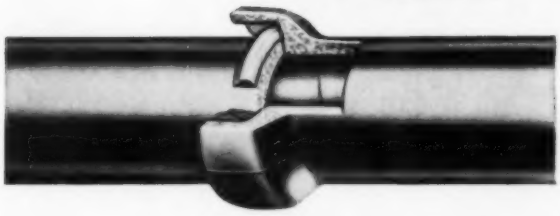
NEW Wedge-Lock* JOINTS

WEDGE IN! LOCK TIGHT!

Stop Infiltration and Roots

Patented Wedge-Lock Joints wedge in and lock tight in one simple, easy operation . . . in continuous compression . . . provide the tightest line . . . stop infiltration and root penetration . . . give easier, faster installation . . . keep installation costs down . . . permit strict adherence to engineered sewer designs . . . last as long as the world's longest-lasting pipe.





Always specify Vitrified Clay Pipe with Wedge-Lock Plastisol Joints.

Write to Listed Manufacturers for literature or an actual Wedge-Lock demonstration.

*Patented. T.M. Reg. U.S. Pat. Off.

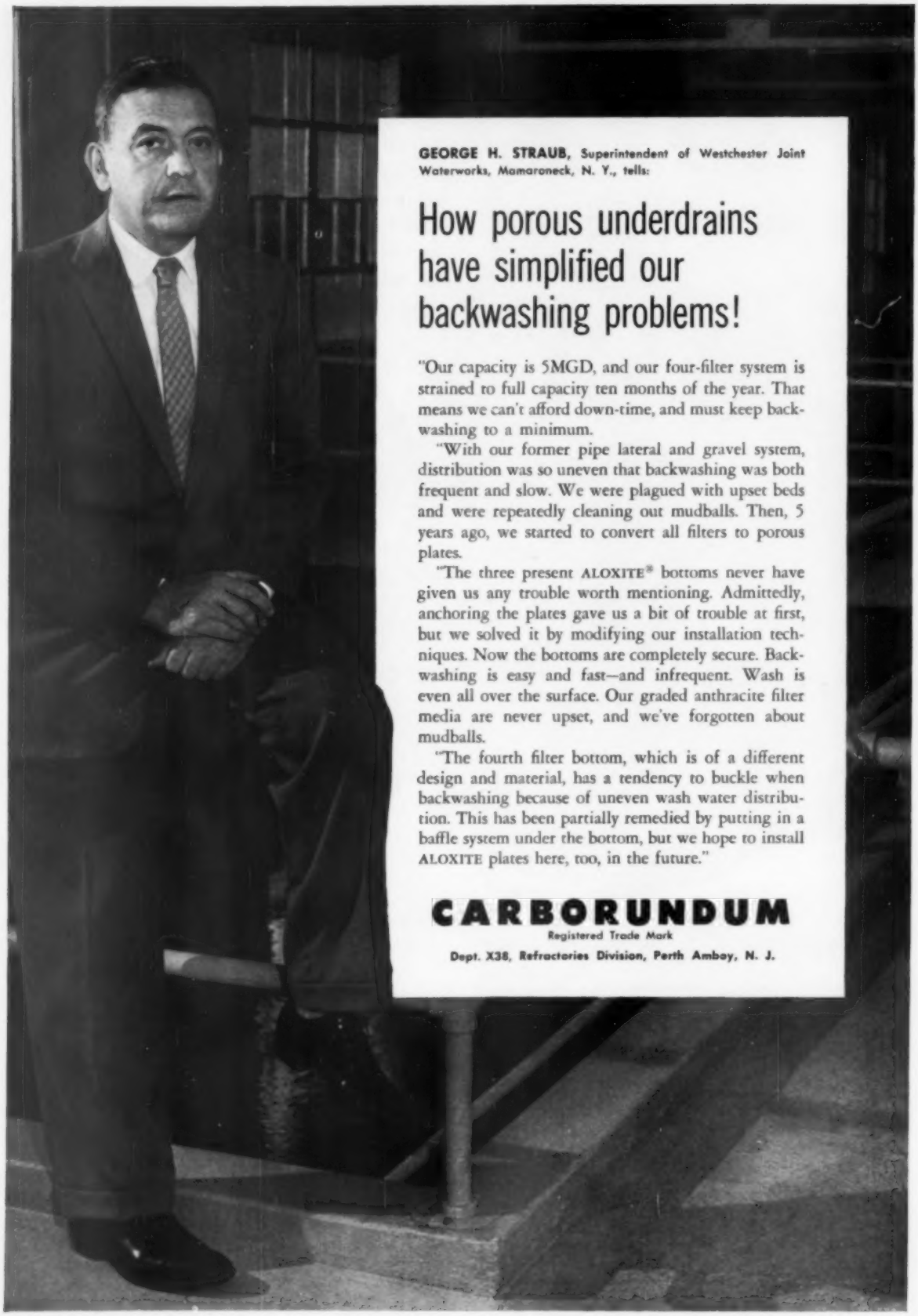
Wedge-Lock CLAY PIPE

THE FACTORY-JOINTED CLAY PIPE AVAILABLE NATIONALLY FROM LOCAL MANUFACTURERS

Order Wedge-Lock from any of these Vitrified Clay Pipe Manufacturers:

Cannelton Sewer Pipe Company, Cannelton, Ind.
Clay City Pipe Company, Uhrichsville, Ohio
The Evans Pipe Company, Uhrichsville, O.
Gladding, McBean & Company, Los Angeles 54, Cal. *(Sold under trade name, "SPEED-SEAL")*
The Logan Clay Products Company, Logan, Ohio
Oconee Clay Products Company, Milledgeville, Ga.
Pacific Clay Products, Los Angeles 54, Calif.
Pine Hall Brick & Pipe Company, Winston-Salem, N.C.
Pomona Terra-Cotta Company, Greensboro, N.C.
The Robinson Clay Product Company, Akron 9, Ohio
The Stillwater Clay Products Company, Cleveland 16, Ohio

WLC-158-31



GEORGE H. STRAUB, Superintendent of Westchester Joint Waterworks, Mamaroneck, N. Y., tells:

How porous underdrains have simplified our backwashing problems!

"Our capacity is 5MGD, and our four-filter system is strained to full capacity ten months of the year. That means we can't afford down-time, and must keep backwashing to a minimum.

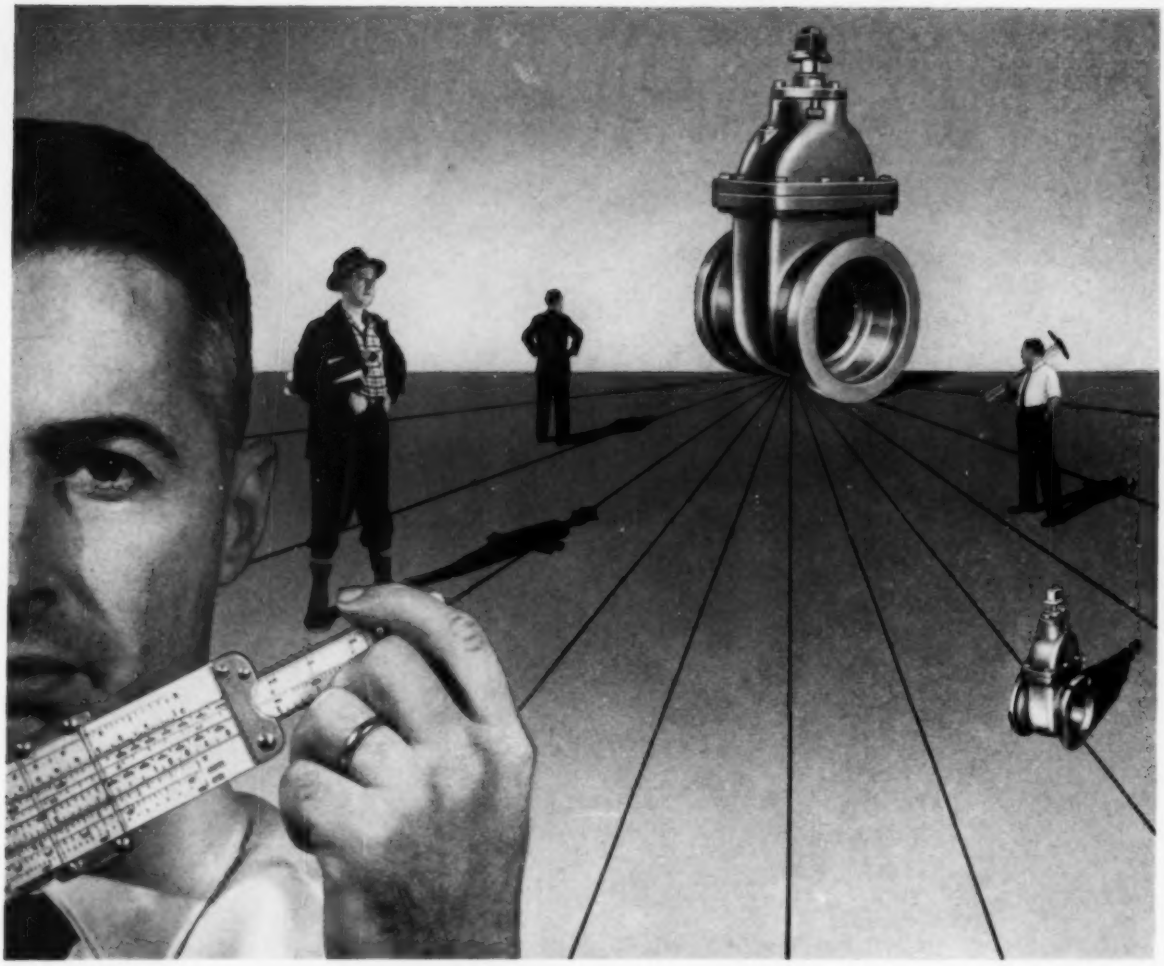
"With our former pipe lateral and gravel system, distribution was so uneven that backwashing was both frequent and slow. We were plagued with upset beds and were repeatedly cleaning out mudballs. Then, 5 years ago, we started to convert all filters to porous plates.

"The three present ALOXITE® bottoms never have given us any trouble worth mentioning. Admittedly, anchoring the plates gave us a bit of trouble at first, but we solved it by modifying our installation techniques. Now the bottoms are completely secure. Backwashing is easy and fast—and infrequent. Wash is even all over the surface. Our graded anthracite filter media are never upset, and we've forgotten about mudballs.

"The fourth filter bottom, which is of a different design and material, has a tendency to buckle when backwashing because of uneven wash water distribution. This has been partially remedied by putting in a baffle system under the bottom, but we hope to install ALOXITE plates here, too, in the future."

CARBORUNDUM
Registered Trade Mark

Dept. X38, Refractories Division, Perth Amboy, N. J.



LET'S CONSIDER THE **PERFECT** GATE VALVE

Sound design and quality workmanship to guarantee ease of operation, watertight closure, years of trouble-free performance

The perfect gate valve, according to engineers and water superintendents, must combine simplicity and soundness of design, tightness of closure, ease of operation and quality of workmanship.

All Ludlow gate valves and all Rensselaer gate valves are designed to meet these requirements, as well as A.W.W.A. specifications.

Among the Ludlow and Rensselaer double disc gate valves you'll find the most complete selection of outstanding design features available today. Sizes range from 2" to 72", plus custom design engineering for special applications.

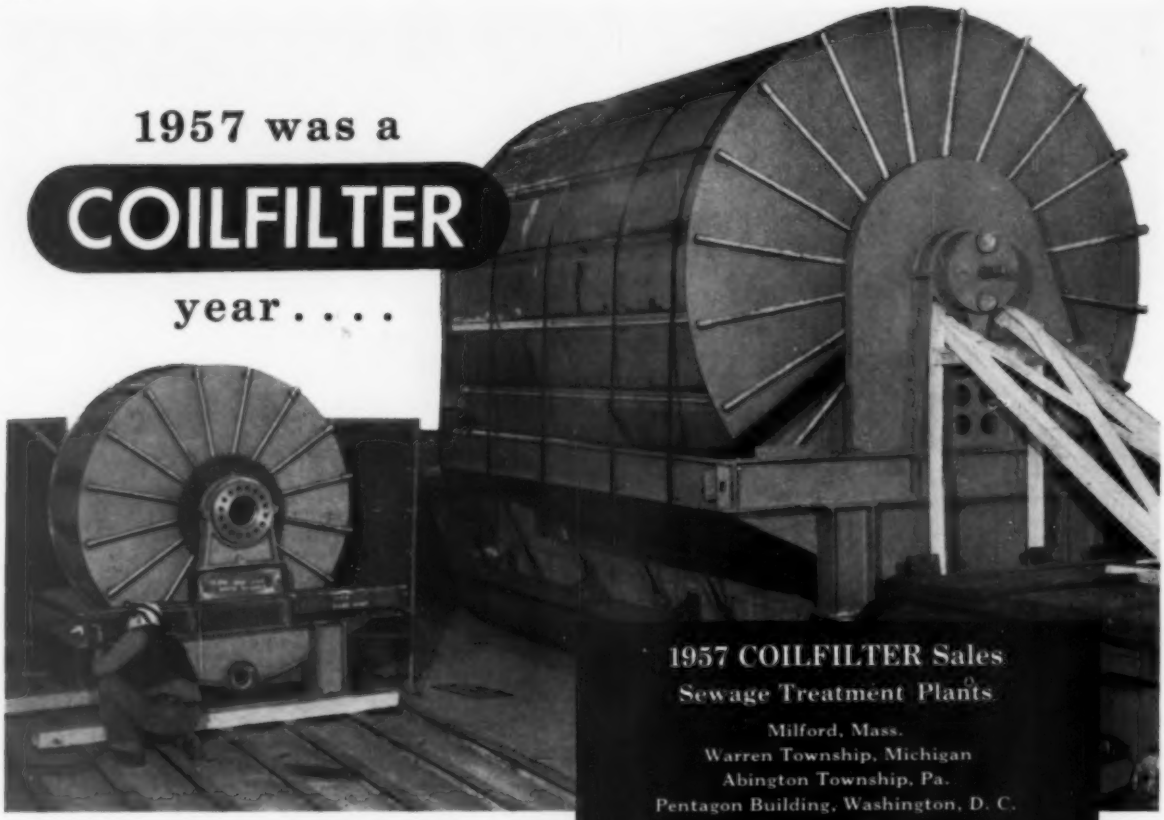
Write today for the L&R Gate Valve Catalogs

LUDLOW & RENSSELAER

VALVES AND HYDRANTS

THE LUDLOW VALVE MANUFACTURING CO., INC., TROY, N. Y.—SINCE 1861

1957 was a COILFILTER year....



. . . and from present indications 1958 will also be a year in which COILFILTERS again will be preferred by most Consultants in the Sanitary Engineering field.

We wish to express our gratitude to the engineers, operators and public officials who have shown their confidence in COILFILTERS. We intend to keep improving and producing the finest product in its field.

Illustrated above; "the big and little of it". The largest and smallest standard COILFILTERS being prepared for shipment to plants in Yorkville, Ohio and Warren, Michigan, respectively.

KOMLINE-SANDERSON ENGINEERING CORPORATION

PEAPACK, NEW JERSEY

Manufacturers of* COILFILTER *sludge vacuum filters

1957 COILFILTER Sales

Sewage Treatment Plants

Milford, Mass.
Warren Township, Michigan
Abington Township, Pa.
Pentagon Building, Washington, D. C.
Carthage, Mo.
Lackawanna, N. Y.
Ridgeland Water Company, Worth Township, Ill.
Hastings, Neb.
Hamilton, Ohio
Salem, Ill.
Oklahoma City, Okla
Perth Amboy, N. J.
Winchester, Va.
Clearwater, Fla.
Carlisle, Pa.
Bethel, Pa.
Corsicana, Texas
Elizabethton, Tenn.
Lebanon, Ind.
Resources Development Corp., Willingboro Township, N. J.
Cozad, Neb.
Yorkville, Ohio
Two Harbors, Minn.
Belvidere, Ill.
East Ridge, Tenn.
Sewickley, Pa.
Dubuque, Iowa
Easton, Pa.
Spring Valley, N. Y.
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COMPOUND METERS

will give you better and longer service than any other Compound Meters

All Bronze Case, sizes 2"–3"–4"–6" inclusive as illustrated above also Iron Case Meters (not shown here) in sizes 8"–10"

only HERSEY *gives you such a large selection of sizes to fit your every need.*

HERSEY MANUFACTURING COMPANY
DEDHAM, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO — SAN FRANCISCO — LOS ANGELES

TRIDENT METERS

EARN MORE

...COST LESS

It takes money to maintain the water supply your community expects. It's vitally important to make sure all the water pumped is paid for . . . by using accurate meters . . . and by keeping these meters in good repair.

Trident meters are built to hold accuracy longer, so you receive all the revenue you should. They're built to be easier to repair, so your shop time and expenses are cut down. They're designed so that the newest parts fit the oldest meters . . . simplifying your repair parts problem, helping you to get accurate, thoroughly modern performance from your oldest meters.

For more than 50 years, Neptune has built fine meters designed to earn more and cost less. Many 50-year-old Tridents are still in service . . . perhaps in your own community . . . living proof that the Tridents you buy today will be a credit to your water system for many long years to come.

277

NEPTUNE METER COMPANY
19 West 50th Street • New York 20, N. Y.

NEPTUNE METERS, LTD.
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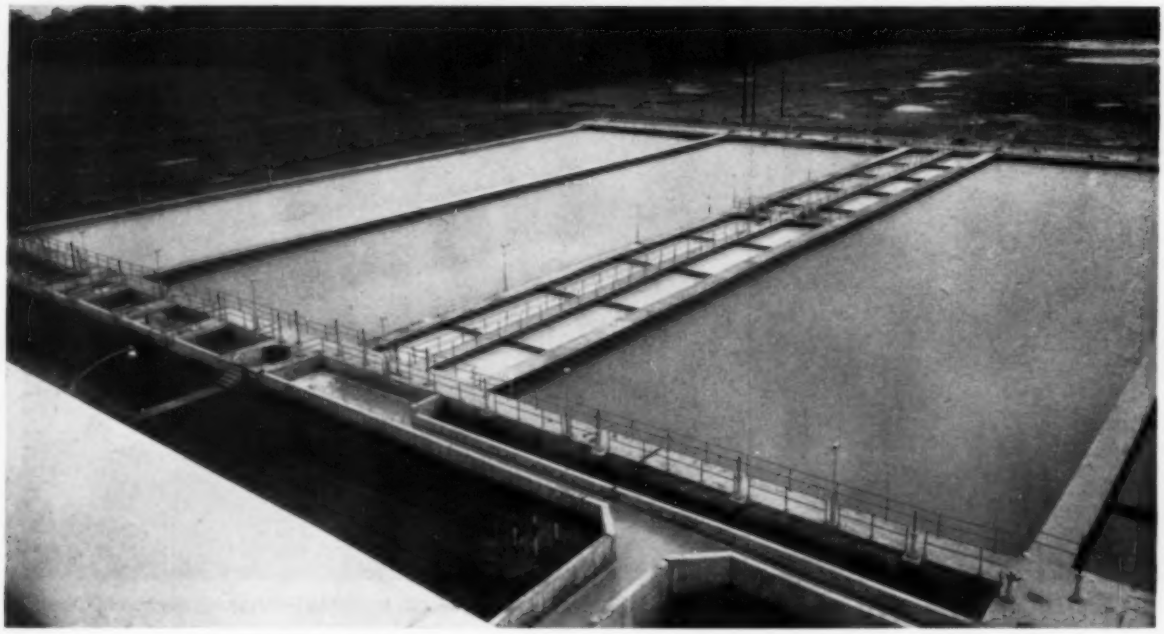
Branch Offices in Principal American and Canadian Cities.

Vol. 105, No. 3 · March, 1958

A Scranton Gillette Publication

WATER & SEWAGE WORKS



MIXING AND SETTLING BASINS serve coagulation and softening process as prelude to filtration at the new 50 mgd . . .

Big Walnut Plant *in Columbus, Ohio.*

■ NOW ROUNDING OUT its first year of successful operation, Big Walnut water treatment plant has helped the City of Columbus, Ohio, meet the rapidly increasing demand for water in this expanding industrial area.

City officials are well satisfied with this multi-million dollar addition to the Columbus water supply facilities, which supplements the existing purification and softening plant on the Scioto River. Placed in operation in June 1956, the Big Walnut plant has performed without serious difficulties at loads ranging from a minimum of 14 mgd to a maximum of 20 mgd.

Seventy-four cast-iron, bronze-mounted sluice gates, including twelve wash drain gates, control the flow of water through the 15-acre treatment plant, which occupies part of a 69-acre tract.

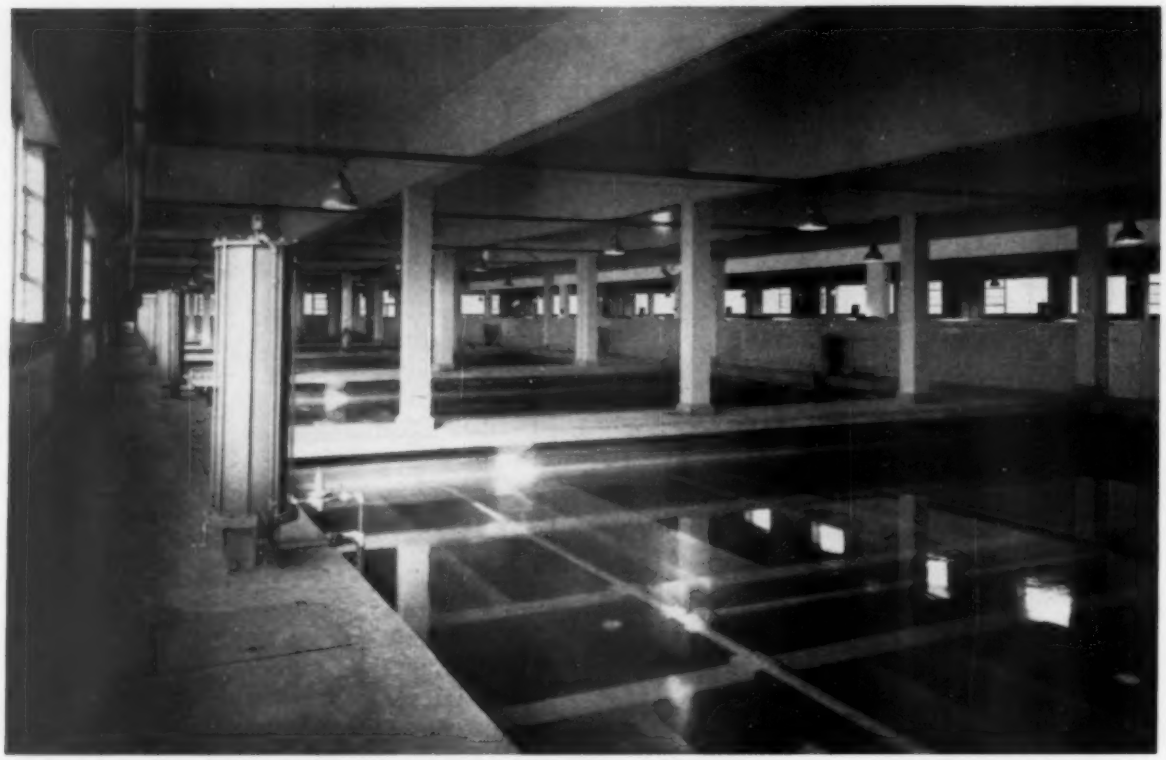
The new plant and the existing one together supply a population of about 500,000 in Columbus and its environs and are geared to the computed safe yield from the 20,000-mg Hoover Reservoir, located about 3½ miles north of the plant. The nominal capacity of the new plant is 50-mgd and its maximum rated capacity is 72-mgd, based on a filtering rate of 3 gpm per square foot. The installed pumping capacity is 100-mgd for both low and high service pumping stations.

Raw water is drawn from a 20-mgd intake pool fed by Hoover Reservoir and brought into the treatment plant through a 72-inch raw water conduit by means of six vertical propeller pumps, arranged in two sets of three. Each set has two 20-mgd pumps and one 10-mgd pump, and its own independent suction well, discharge pipeline, venturi meter, and electrical supply. The 20-mgd pumps are powered by 150-hp induction motors and the 10-mgd pumps have 75-hp induction motors. Between the raw water intake and the intake pumps, sluice gates control the flow of water as it travels through three 25-mgd traveling intake screens each having baskets that are 6 feet in width with screen openings of ⅜ inch.

Treatment

Raw water from the low service pumps is discharged into a concrete channel that passes under the main floor of the chemical building, where the water is treated with chemicals from feeding machines located over

Ed. Note: All photos courtesy of Rodney Hunt Machine Co., Orange, Mass.



TWELVE SAND FILTERS are equipped with automatic table controls, hydraulically operated wash water and drain gates, and surface wash agitators.

the channel. This channel and the following flocculation tanks and settling basins were designed to give the operators the option of split treatment, with sedimentation and odor control in the first pass followed by softening in the second pass, or combined sedimentation and softening in one pass.

For split treatment, copper sulfate, activated carbon, alum and chlorine can be added to the water in its first pass through the chemical building. Lime can also be added if needed. The chemically treated water then flows to flocculation tanks No. 1 and 2, which are located between settling basins No. 1 and 2.

Each flocculation tank is 17 feet wide by 350 feet long and has an average water depth of 17.5 feet. The flocculation time is about 45 minutes when the plant is operating at the 50-mgd rate. To expedite flocculation, each tank is equipped with horizontal shaft paddle wheels that are in two sections each 170 feet long. The size of the paddle blades, the length of the arms, and the rotational speed of the two sections were designed for tapered mixing. Short-circulating is prevented by baffles set on 17-foot centers.

The flocculated water from these two tanks then flows through a distribution channel to one of four settling basins, each of which is 100 feet wide, 350 feet long, and has an average water depth of 15 feet. With split treatment, however, the water is directed into basin No. 1, and returns toward the chemical building through this basin. The surface loading of this tank at the 50-mgd rate is 1,430 gpd per square foot, or about 1 gpm per square foot. The basin is equipped with conveyor-type sludge collectors for the first 180 feet of its length. The remaining 170 feet of the basin will be cleaned manually as needed.

Deflocculated water returns to the chemical building, where it receives lime soda ash. Small amounts of alum will also be added if needed. The water then flows to flocculation tanks No. 3 and 4, which are located between settling basins No. 2 and 3. These tanks are identical to flocculation tanks No. 1 and 2.

Flocculated water from tanks No. 3 and 4 normally flows into settling basins No. 2 and 3, but it can also be directed into basins No. 1 and 4 if abnormal conditions should make this necessary. Because the water is returning toward the chemical building through these two basins in parallel, the surface loading is only about ½ gpm per square foot. These basins are equipped with sludge removal equipment identical to that in basin No. 1. The sludge from these basins is principally calcium carbonate; therefore, it is kept separate from the mud and organic materials that settle in basin No. 1. At present the chemical sludge is being stored in a lagoon north of the basins. Operating experience has shown that sludge can be removed continuously from these basins.

The softened water emerging from basins No. 2 and 3 is recarbonated by means of underwater gas burners located in the channel between basin

No. 3 and basin No. 4. In this last basin, where the recarbonation reaction is allowed to run its course for the proper length of time, the water flows from south to north, which is the reverse of the flow in the other three basins. Basin No. 4 is not equipped with mechanical sludge collectors, as only a small amount of sludge is expected to settle in it.

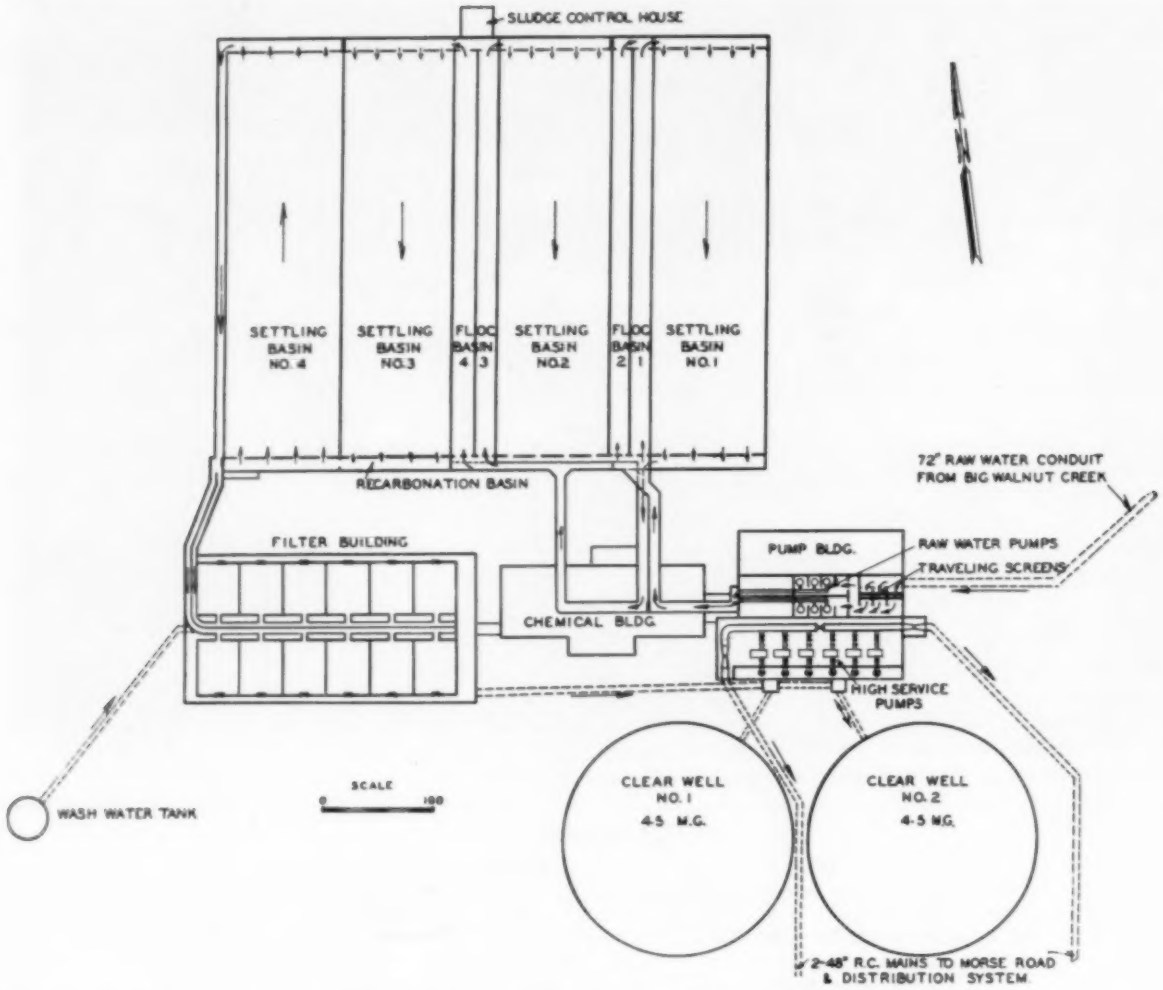
Cast-iron bronze-mounted sluice gates are installed at both the inlets and the outlets of all of these basins. With such a large number of sluice gates it is important to insure unfailing operation, because downtime on any one gate could possibly throw a major part of the plant out of operation. The gates, therefore, have bronze facings sealing against bronze seat facings, thus eliminating the possibility of corrosion in that critical area.

Installation of sluice gates at all basin outlets and inlets permits the basins to be used either in parallel or in series, and allows any basins to be taken out of service. Furthermore, the flow through basin No. 4 can be reversed if that basin should be needed

HEAVY SPRING FLOW sweeps over intake dam; bar screen building is located at far end of dam.

PLANT STATISTICS

Unit	Number	Size and Capacity
Intake dam, concrete gravity, ogee section	1	Length 200 ft, height 6 ft
Intake pool, storage	1	20 million gal.
Raw water conduit, reinf. concrete	1	Diameter 72 in., length 1,366 ft
Pump building:		
Traveling water screen	3	25 mgd each
Low-lift pump	4	20 mgd, 150 hp
	2	10 mgd, 75 hp
Electrical substation	1	7,500 kva
	1	2,000 kva
Chemical building:		
Copper sulfate feeder	1	
Activated carbon feeder	2	
Alum feeder	2	2,000 lb per hr
Lime feeder	2	2,000 lb per hr
Soda ash feeder	2	1,500 lb per hr
Chlorine machine	1	4,000 lb per day
Alum storage bin	2	7,400 cu ft each
Lime storage bin	2	7,400 cu ft each
Soda ash storage bin	2	7,400 cu ft each
Carbon slurry bin	6	9,000 lb each
Chlorine	--	2,000-lb cylinder
Flocculating and settling:		
Flocculation tank	4	750,000 gal. each
Settling basin	4	4 mgd each
Submerged CO_2 generator	3	4,000 lb per day each
Filter building:		
Rapid sand filter	12	4.2 mgd each; total 50 mgd
Post-chlorination machine	2	150 lb per day each
Polyphosphate feeder	2	15 lb per hr each
Clear wells:		
Filter building	--	3 mgd
Service	2	4,5 mg
Wash water tank	1	218,000 gal.



THE FLOW PATH from raw water to finished effluent shown in this diagram indicates a compact arrangement.

for softening treatment more than for recarbonation reaction. A total of 51 sluice gates, ranging in size from 48 by 36 to 96 by 96 inches, were installed to provide this flexibility of control. All sluice gates in the flocculating tanks and settling basins are operated by a portable gate operator. A workman can easily move the portable operator about from gate to gate.

Filtration

Softened and recarbonated water from the settling basins then flows through an underground conduit to the filter building, where it enters a double conduit. One side of this conduit supplies the south bank of six filters; the other side delivers water to the north bank of six filters. This arrangement allows either bank of filters to be continued in operation while maintenance is being carried out on the other bank.

Each of the twelve filters has an area of 1,410 square feet. At a filtering rate of 3 gpm per square foot, the total capacity of all twelve filters is a maximum of 73 mgd. However, the objective is to maintain at least ten filters in operation all the time, which would allow the plant to process 60 mgd of water in the future. The rate-of-flow controllers for the filters have a range of 1.7 mgd to 6.5 mgd. They are controlled pneumatically by a centrally located master control system that keeps all filters operating at the same rate. The controllers will automatically shut off all filters on low water in the influent channels from the settling basins or on high water in the clear wells.

The filters have ceramic tile bottoms with a center influent conduit under the wash water gullet. A 12-inch layer of gravel ranging in size from ¾-inch maximum to ⅛-inch minimum covers the perforated tile bottom. A 3-inch layer of torpedo sand (0.8 mm to 1.20 mm) separates the gravel from a 24-inch layer of sand having an effective size of 0.40 mm to 0.50 mm.

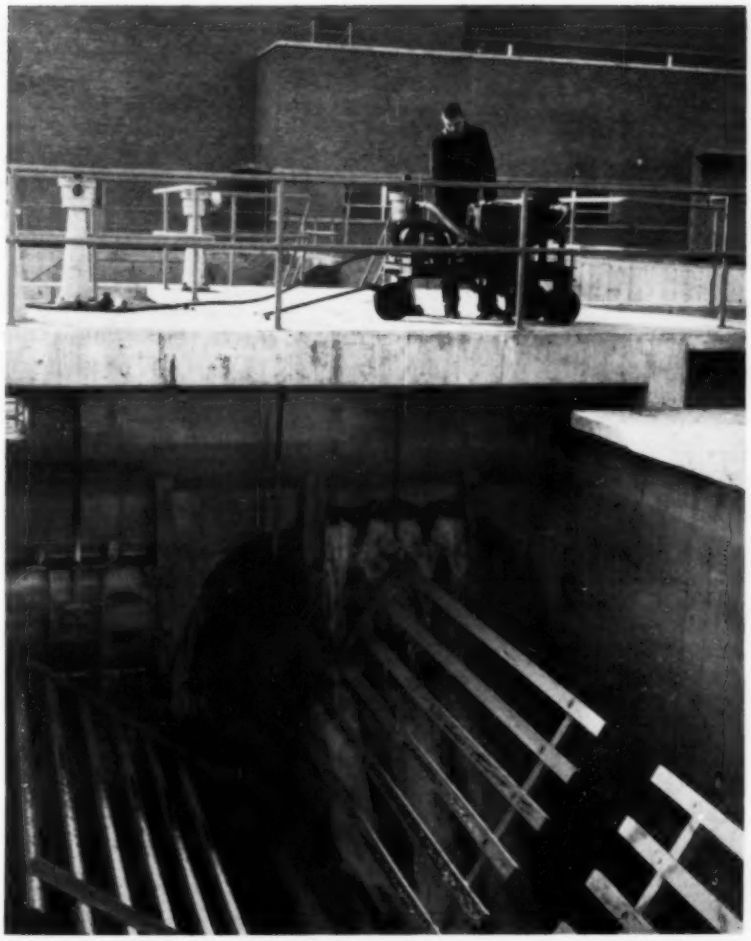
The designed backwash rate is 30 inches rise or 18.75 gpm per square foot. This rate requires 27,100 gpm for filter washing. A wash water tank holding 218,000 gallons is located on

the high ground southwest of the filter building. The tank is filled by two 6,500-gpm pumps drawing from clear wells under the filters. These pumps start operating whenever the water level in the tank drops one foot. Normally, wash water is returned to the screen channel in the pump building and is not wasted. However, whenever sand is being removed from the filters, the wash water can be discharged to the creek below the intake dam.

The now fully purified water is stored ready for use in two underground 4½-mg clear wells. From the wells the water is pumped to the distribution system through two 48-inch mains.

Costs and Engineers

Construction costs of the intake dam and raw water conduit totaled about $300,750. For the treatment plant and pumping station the construction costs were about $5,750,000. The plant was designed by Uhlmann & Associates, consulting engineers, Columbus, Ohio.



PORTABLE OPERATORS are used to ► open and close most of the plant's sluice gates. The large rotating paddles in the flocculating tanks are in double units, each 170 ft. long.

Walter Picton Named Director Water & Sewage BDSA

In line with its new policy of appointing career men to head the 24 industry divisions of the Business and Defense Services Administration, U.S. Dept. of Commerce, the Department has announced the appointment of Walter L. Picton as Director, Water and Sewerage Industry and Utilities Division.

Mr. Picton is a native of Nashville, Tenn., and an engineering graduate of Vanderbilt University. After 21 years in private practice, principally as consulting engineer on public improvements in the South and midwest, Mr. Picton came to Washington in 1942 to join the War Production Board. At the end of World War II, he went into the Public Health Service, and then The Institute of Inter-American Affairs in Mexico. Returning to Washington, he was with the National Security Resources Board, and later the National Production Authority, which became the BDSA. He has been serving as deputy director of the unit he now heads.

A.W.W.A. Plans Tours to Dallas

The Transportation Committee of AWWA has planned three tours in conjunction with the 78th Annual Conference scheduled for Dallas, Texas, April 20-25.

Tour A is the grand tour providing an all-expense trip enroute to Dallas via New Orleans and return from Dallas via Hot Springs, Ark. This trip will leave New York via Penna. R.R. on Tues., April 15 (picking up other passengers along the way) and will arrive in New Orleans Thursday a.m. April 17. Stopover will be at the Hotel St. Charles with trips to Lake Pontchartrain, Old Garden District, various famous restaurants and a gay night life tour. Saturday will include brunch at Brennan's and a free day. The train leaves New Orleans Saturday evening April 19 and arrives in Dallas Sunday morning.

The return trip will leave Dallas Friday night April 25; it will arrive in Little Rock, Ark. Saturday morning and leave before noon for Hot Springs National Park. Two days are available for fun and relaxation including bus tours of the area. The train departs Monday night and arrives in St. Louis Tuesday Morning April 29, and then on to New York where it arrives Wednesday April 30.

Tour B provides for the trip to Dallas via New Orleans and a direct return to New York.

Tour C provides for a direct trip to Dallas and a return by Hot Springs.

Tour D is a direct trip to and from Dallas. Transportation by air may also be arranged.

In this age of nuclear testing and resulting fallout, one interesting observation is the effect of

Radio-active Rains *on surface water supplies*

by R. L. MORRIS, Chief Chemist State Hygienic Laboratory and Assistant Professor of Hygiene and Preventative Medicine. State University of Iowa in Iowa City, Iowa.

RESUMÉ: Studies were made on the Iowa River and selected farm ponds from July to October, 1957. Analyses made following rains showed a sharp increase in radioactivity of these surface waters following ten significant rains, which were preceded by above normal air activity levels which usually could be correlated to recent bomb detonations in Nevada. Duration of above maximum permissible concentration (100 mu mu c per liter of beta-gamma activity) in the Iowa River was short due to rapid flow rate, but in the ponds duration more than 100 mu mu c per liter was far longer. Most of the radioactivity in the river was in the suspended solids, and in the ponds was concentrated in the algae.

The author believes that due to radioactive fallout in Iowa, farm ponds warrant careful consideration before use as sources of potable water supply when evaluated according to NBS maximum permissible limits.

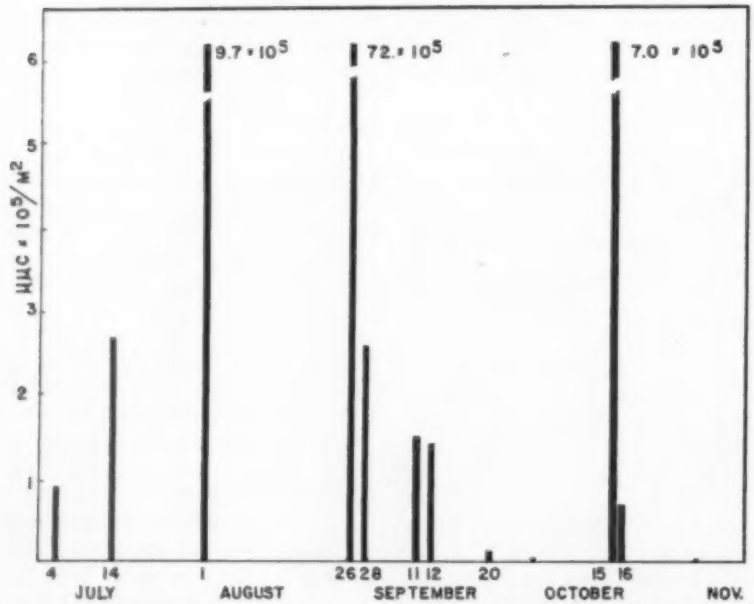


Fig. 1—GROSS BETA-GAMMA activity per square meter of significant precipitations at Iowa City causing radio activity elevations in Iowa River.

■ GROUND WATER SUPPLIES in southern Iowa and areas of several surrounding states have diminished in recent years due to drouth conditions. Therefore, increasing reliance is being placed on both dynamic and static surface supplies and a definite trend is developing toward use of farm ponds for the supply of potable water for human use as the traditional ground water supply deteriorates in both quantity and quality.

TABLE 1

Radioactive Rainfall at Iowa City, Iowa

Date (1957)	Activity (Beta-Gamma) μμc/l	Activity (Beta-Gamma) μμc/sq m	Amount of Rain, mm
7/1	2,260	4,410	1.95
7/4	7,600	91,200	12.04
7/8	18,338	91,690	5.00
7/14	38,500	274,000	7.12
7/22	3,022	55,600	18.38
8/1	78,300	967,300	12.50
8/24	17,057	21,321	1.25
8/26	14,400,000	7,200,000	0.50
8/27	110,200	55,100	0.50
8/28	6,450	258,000	40+
9/11	26,500	152,375	5.75
9/12	13,090	137,445	10.50
9/20	811	14,801	18.25
10/15	23,400	700,000	29.56
10/16	7,759	66,700	8.58

TABLE 2

Radioactivity Levels (in $\mu\mu$ c/l) of Iowa River at Iowa City, Iowa

Date (1957)	Dissolved Solids	Total Solids	University Tap Water
7/5	28.3	35.7	——
7/6	47.1	149.7	——
7/7	85.6	401.6	——
7/9	65.7	162.5	——
7/11	15.4	30.6	——
7/16	37.1	123.1	——
7/25	25.3	25.3	——
7/30	38.2	54.7	——
8/1	69.0	242.2	——
8/3	95.6	240.4	——
8/6	103.5	191.4	——
8/8	70.2	97.0	——
8/12	57.1	75.4	——
8/14	28.0	71.6	40.1
8/22	10.6	48.0	11.3
8/26	95.9	——	9.2
8/27	64.9	——	73.6
8/28	150.9	895.9	74.1
8/29	224.0	366.0	221.1
8/30	106.5	169.1	74.5
8/31	67.3	102.1	93.0
9/4	69.4	69.4	46.1
9/10	44.3	54.5	44.3
9/12	135.0	311.0	162
9/13	52.9	105.2	53.9
9/24	30.3	39.4	——
9/25	160.5	184.4	16.9
9/26	175.6	180.9	18.1
9/27	36.7	41.0	24.4
10/14	13.6	18.6	15.0
10/15	53.2	114.5	——
10/16	37.7	150.1	51.6
10/18	84.6	121.5	64.6
10/20	52.1	101.7	——
10/27	20.3	42.2	——

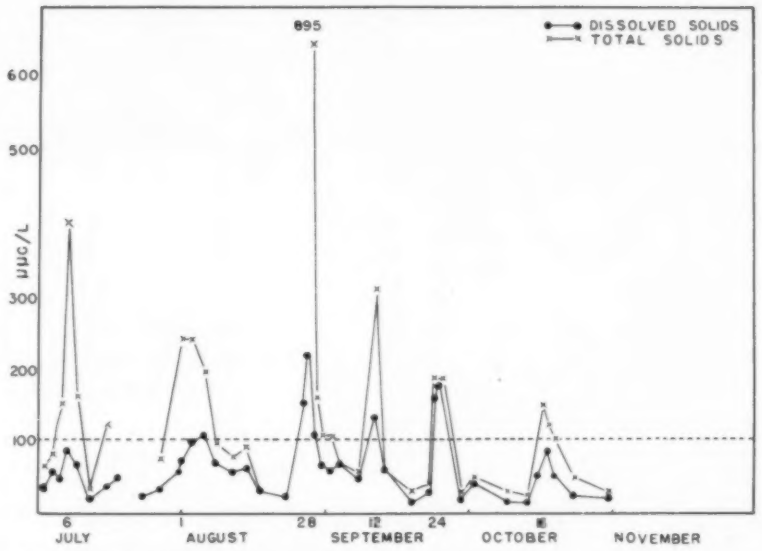


Fig. 2—EFFECT of significant rains on radioactivity level of the Iowa River.

Radioactive rains and some of their effects on water supplies were reported in Massachusetts by Rosenthal[1] in 1953 and in Cincinnati by Setter and Goldin[2] in 1957. Increases in gross beta-gamma radioactivity in the air at Iowa City, Iowa, subsequent to several 1957 Nevada site detonations correlated with elevation of activity in rainfall occurring during this period. The levels of activity recorded in Iowa City were sufficiently higher than those previously reported so that the advisability of a thorough investigation into the radiological aspects of small impoundment water supplies was indicated.

Samples of all precipitation, along with daily specimens of the Iowa River were obtained at Iowa City during the months of July through October. Weekly samples were secured from several typical farm ponds in Johnson County and various other counties in southern Iowa. Samples were evaporated to dryness and counted in an internal proportional counter* according to methods recommended by the U. S. Public Health Service.[3]

National Bureau of Standards Handbook 52[4] covering maximum permissible concentrations of radioisotopes in water states, "10^{-7} μc/ml beta or gamma emitters are believed to be safe for exposure to any of the radioisotopes for periods of a few months." This level applies to all isotopes except Ra^{226}, Pu^{239} and Sr^{90}, all of which have significantly lower maximum permissible concentrations. It is recommended by Handbook 52 that average operating levels should be kept as far below these values as possible, and not above them for any extended period of time. The value of 10^{-7} μc per ml was recalculated to be 100 $\mu\mu$c per liter and this value has been assumed as the acceptable level for both river and impoundment waters when anticipated for human use.

Table 1 shows the amount and activity of rains during July-October 1957; Fig. 1 presents the gross beta-gamma activity per square meter of those significant precipitations causing activity elevations in the Iowa River. This latter value is a function of the depth of rain which fell and its radioactive content per volume.

Rains having above-normal activity were invariably preceded by air activity levels several times the natural background. These air level increases usually could be correlated with recent bomb detonations in Nevada, and decay data on the collected rain samples showed the isotopes to have half-lives of from 5 to 9 days. Ten significant rains were recorded in this four-month period and their effect on the Iowa River is shown in Fig. 2.

Seven periods of above-normal radioactivity in precipitations were recorded, respectively, on July 4, July 14, Aug. 1, Aug. 26 and 28, Sept. 11 and 12, Sept. 20, and Oct. 15 and 16. Six of these incidents were evidenced by marked rises in Iowa River radioactivity levels. Results of pertinent dissolved and total solids radioactivity analyses of the Iowa River are given in Table 2. Specimens were collected and run daily, but only relevant changes in activity are recorded here.

Unfortunately, river samples were not run subsequent to the rain of July 14, but the effect of this precipitation was demonstrated by the high beta-gamma level of the Beaver farm pond on July 15 (Fig. 3). Figure 2 indicates that a large percentage of the activity in the Iowa River is contained as suspended solids and suggests that sedimentation, coagulation and filtration would effectively remove major portions of the total activity. Analyses of the Iowa University tap water, which is the result of this type of treatment, bear out this premise.

* Manufactured by Nuclear Measurements Corp.

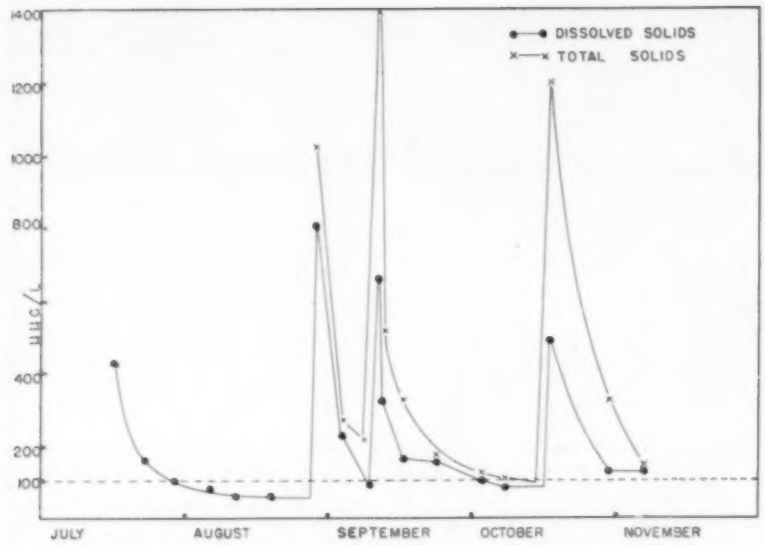


Fig. 3—EFFECT of significant rains on radioactivity level of the Beaver farm pond.

The increase of activity in the Iowa River was extensive and sharp following signiflcant rains, but the duration above the maximum permissible concentration of 100 $\mu\mu$c per liter was quite short. This is probably due to the narrow restricted watershed of this river and its rather rapid rate of flow. A total of 7 days out of four months were recorded above 100 $\mu\mu$c per liter for dissolved solids, with 28 days above this level for total solids. The average gross beta-gamma counts based on daily records for individual months are shown in Table 3.

Interest in the radiological aspects of farm ponds developed on July 15, when several ponds around Iowa City were tested and found to be well above the maximum permissible concentration for continual drinking purposes. Figure 3 and Table 4 give the results of weekly specimens obtained from the Beaver farm pond. The increase in gross activity is much greater for this farm pond than was shown for similar periods on the Iowa River, and the duration is far longer. From July 15 through October the dissolved solids activity was above 100 $\mu\mu$c per liter for 60 days, with the total solids being above this level for 64 days out of the 80 days covered.

TABLE 3

Monthly Averages of Daily Radioactivity Levels of the Iowa River (in $\mu\mu$ c/l)

Month (1957)	Dissolved Solids	Total Solids	University Tap Water
July	35.4	78.3	.....
Aug.	62.0	138.0	51.6
Sept.	54.5	80.7	40.2
Oct.	27.8	48.0	29.3

The failure of the Beaver pond activity levels to evidence the rains of August 1 and September 20 is probably due to the spotty character of summer rains, as it was noted that some of the farm ponds being studied did show activity increases following these two precipitations. Table 5 gives some beta-gamma levels obtained on farm ponds in areas other than Iowa City.

Relatively large algae growth existed in the Beaver pond and was identified as *Ulothrix* and *Microspora* primarily. Table 4 shows that the algae concentrates significant amounts of the activity. Cattle wade in the edges of these ponds and stir up the border algae growth extensively. Their drinking water quality is best illustrated by the activity in the total solids after agitation (Table 4). Obviously, a cattle watering supply of considerably lower activity could be provided by overflow into a watering trough below the pond dam.

Some evidence has been accumulated to show that high winds effect mixing of the algae particles and the supernatant water causing abnormally high total solids activity at times. These data indicate that this activity

TABLE 4

Radioactivity Levels of Beaver Farm Pond (in $\mu\mu$ c/l)

Date	Before Agitation		After Agit.	
(1957)	Diss. Sol.	Tot. Sol.	Tot. Sol.	Algae
7/15	438	.....	.....	.....
7/21	159	159	.....	.....
7/26	101	.....	.....	.....
8/5	81	.....	.....	.....
8/11	66	72	.....	.....
8/18	64	64	.....	.....
8/28	800	1,023	.....	.....
9/3	225	244	.....	.....
9/9	93	213	.....	.....
9/11	653	1,400	1,418	.....
9/12	327	523	914	.....
9/16	166	329	595	1,875
9/23	161	169	332	1,900
10/2	100	108	132	336
10/7	82	93	586	913
10/16	490	1,180	1,400	.....
10/28	123	325	460	.....
11/6	125	125	213	.....

increase in turbid farm pond samples is primarily due to the algae particles and not by stirred up bottom sediment.

The frequency, duration and concentration of radioactive fallout particles in Iowa farm ponds is sufficient to warrant careful consideration regarding their use as sources of potable water supply when evaluated according to current National Bureau of Standards maximum permissible limits.

Studies of specific concentrations of the more stable isotopes in these ponds are contemplated.

References

1. Rosenthal, B. L., "Radioactive Rainfall Found in Massachusetts," *Sanitalk* (Nov. 1954).
2. Setter, L. R., and Goldin, A. S., "Radioactive Fallout in Surface Waters." *Ind. Eng. Chem.*, 48: 251 (Feb. 1956).
3. Robert A. Taft Sanitary Engineering Center, "A Method for Determination of Radioactivity in Water" (May 1954).
4. National Bureau of Standards, U. S. Dept. of Commerce, Handbook 52, "Maximum Permissible Amounts of Radioisotopes in the Human Body and Maximum Permissible Concentrations in Air and Water," pp. 10-12 (Mar. 1953).

TABLE 5

Miscellaneous Farm Pond Radioactivity Levels (in $\mu\mu$ c/l)

Date (1957)	Location	Diss. Sol.	Tot. Sol.
9/17	Albia I	135	182
10/1	Albia I	18	25
9/17	Albia II	152	206
10/1	Albia II	47	47
9/18	Bedford I	122	147
9/18	Bedford II	121	133
9/19	Indianola I	100	105
9/19	Indianola II	155	224
10/2	Indianola I	58	58
10/2	Indianola II	51	68

A taste and odor problem, the "chronic" complainer, and a program to forestall . . .

Consumer Complaints, are discussed in these reports from three different water companies in Illinois.

By ROBERT E. HOLLANDER, Ass't. Supt. of Public Works, Palatine, G. V. SCHULTETUS, Ass't. Treasurer, Kankakee Water Co., Kankakee, and G. LELAND WATSON, Supt. of Water, Lake Forest.

EDITOR'S NOTE: These three papers* provide a behind-the-scenes glimpse of the different steps taken by these companies to assure prompt response to complaints and inquiries. They also point out the necessity of constantly adhering to the principle of maintaining the friendliest of customer relations. Such a policy assures a more receptive acceptance of rate increases or new bond issue requirements.

Palatine, Ill.

The case for Palatine was stated by Robert E. Hollander, and deals particularly with taste and odor complaints.

History

The Palatine municipal water system was begun in 1897. Many of the original mains were laid by private subdividers without regard to the circulation and capacity of the overall system. As a result, most of our older sections are served by four-inch mains and contain many dead ends, some of which have been caused by the failure of old and substandard valves. Because of a recent bond issue this picture will be much brighter in the near future, but it is the present which concerns us now.

Old water records indicate a usage of less than two million gallons a year or about what we now pump in two days. As the town grew, new wells were drilled and the old ones abandoned. Until 1954 our water was supplied by gravel and limestone wells which produced water of considerable hardness but which contained little iron. Two of the wells which we still use were chlorinated with a residual at the wells of about 8/10 ppm.

Complaints About Taste and Odor

Taste and odor complaints were few but steady and hydrants were flushed each year. When it became apparent that these wells, with a combined capacity of four hundred gallons per minute would not be sufficient, a new well was drilled 1,290 feet into Galesville sandstone. The first tests indicated a water of less hardness but with 6/10 ppm of iron. We placed this well in service early in 1954 without chlorination, and by August we were writing appeals to various agencies because of the condition of the water in the older sections of town. As the year went on the complaints increased greatly in volume and irate citizens came into the office with samples of foul-smelling, blue-black water. We were often accused of having cross-connected the water mains with the sewage system.

As we received these complaints we flushed the hydrants in their general area but relief obtained by this method was quite temporary. It took only a few days for the water to regain its sewage type odor and black color. I cannot report on the taste of this water as I never talked to anyone who would drink it. Many theories as to the cause of this condition were discussed but for the first year we could do nothing but flush hydrants and experiment with the sources of supply. As all three wells pump directly into the same system we tried cutting back on the supply from one or another but this seemed only to move the complaints from one area to another.

Chlorination Starts

After a year of this condition we decided to try chlorinating the water from the deep well. It still seemed unnecessary to many people to add a sterilizing agent to water from such a source, and it was not until late in 1955 that we were able to order a chlorinator. The unit we received was a 25-pound per day machine which had been converted to 50 pounds per day. This machine should have been big enough for the well but because of the large amount of hydrogen sulphide we had to convert it again to 75 pounds per day in order to get any residual away from the pump house. The addition of chorine helped quite a bit in the older sections, as long as we kept flushing hydrants and bringing fresh chlorinated water into the old mains. It also started a new rash of complaints from more recent sections. The water in some newer sections tasted like some kind of bitter medicine, which we decided was phenol from the bituminous pipe coating. We may or may not have been right, but at any rate this taste soon disappeared. We also heard from the residents near the pump house about the chlorine odor.

Oddly enough, the solution to this problem was to increase the feed of chlorine. At a certain dosage the chlorine odor disappeared, even at the testing tap a few feet downstream from the point of application. The orthotolidine test indicated a residual

* Presented before the Northern Illinois Water Plant Operators Conference, Park Forrest, Illinois.

of two parts per million at this point.

Polyphosphates Added

We had been visited from time to time by representatives of various chemical companies selling polyphosphates for water treatment. We had been mildly interested in them for years because of the tendency of the water to leave stains on porcelain fixtures. Although there have been many other claims for polyphosphate treatment, this was the only point that we had heard substantiated. About the time we installed the chlorinator we were offered a test set-up by the same company that supplies our chlorine. As we were ready to try anything for relief about that time we presented the idea to the Board of Trustees, many of whom lived in the more afflicted areas, and it was quickly approved. For the test set-up the polyphosphate solution was mixed in plastic drums and we used small proportioning pumps to feed it into the well discharge against the main pressure. This arrangement was susceptible to frequent stoppage as the pumps became airbound from small bubbles forming in the suction line. We have recently changed this system to pump through the well seal into the casing. For what it is worth, this also treats the water before it enters the pump bowls.

We also replaced the plastic drums with galvanized tanks of a larger capacity. The polyphosphate crystals are dissolved in the tanks at the rate of a pound per gallon of water. This solution is pumped into the well casing at the rate of one gallon per twenty-four thousand gallons of water pumped. This costs us about one cent per thousand gallons of treated water.

Complaints Subside

It did not take long to notice the effects of this treatment. At first, our complaints stopped almost completely. This situation lasted for a few months and then we began to get isolated complaints with no particular pattern. The water would be clean one moment and all of a sudden everything would seem to break loose at once. In some very old houses the water turned to a red mud which actually stopped the flow to the toilet tanks. This was rare and limited to homes with exceptionally long service pipes. This condition would occur only in one house at a time and would quickly clear up. These occurences would not stop the water meters and, to the contrary, the rate of meter stoppages slid to nothing.

In the past, each meter reading would turn up five or six stopped meters. Upon removal, these meters were found to be encrusted on the inside with a very hard scale, which would resist even a steel rotary brush and which had to be tediously chiseled off with a sharp instrument. A few months after starting polyphosphate treatment meters which were removed for routine cleaning were found to contain only a soft coating which was easily wiped off with a rag. What few meters we remove now because of worn parts we replace with new meters in an attempt to standardize on one make. Consequently, our meter repair has been minimized. If credit can be given to the polyphosphate in this case it has more than paid for itself.

Stubborn Odor Cases Solved

In 1956 both our population and volume of water billed were considerably greater than in 1955 but we pumped about five million gallons less than in the previous year. We did not flush our hydrants in 1956 for the first time in many years and complaints are few and scattered. Some of these remain in situations involving odor were quite stubborn. In one home belonging to a village official the hot water had a very strong sulphur odor. As this home had a late model, glass lined heater, we did not suspect anything to be wrong with it. In an effort to sterilize the entire system we added calcium hypochlorite tablets to the water meters. This treatment would stop the odor for a week or two. Finally we asked the owner to call the manufacturer of the tank and we discovered that the tank contained a magnesium rod. When the tank was replaced the odor disappeared. We had known the effects of these sacrificial elements in our water, but had not been aware of their use in glass lined tanks. This information helped us in other similar situations.

Some of these stubborn cases evidently involved nuisance bacteria. In one case we were able to clear up an odor complaint by sterilizing a very old sidearm heater. In another instance the water in the toilet tanks appeared to be boiling and was emitting a strong odor. We finally discovered a closed main valve which had left this service on the end of a long dead end. When we restored circulation the problem cleared up.

Any conclusions on our experience will have to be guess-work because we did not carry on our experimenting with laboratory control. We were only trying to upgrade our water and were working mostly in the dark Many of the clues we received were from the State's short course at Urbana and they were always most helpful and cooperative. It was through this course that we first heard of iron and sulphur reducing nuisance bacteria which had caused situations similar to our own. When we observed a sample of bad water under a microscope, we found organisms which fit perfectly the description and illustrations we received from the University of Illinois. I believe that the polyphosphate's wetting action allowed the chlorinated water to penetrate scale deposits in the old mains and thereby arrested the growth of the nuisance bacteria. At one point we tried various algaecides, but these did not work without polyphosphate treatment. A recent stoppage of the proportioning pump proves that this treatment is still needed. I do not believe we will ever have perfectly clean mains, but as long as we maintain our present treatment our taste and odor problems should be solved.

* * * * *

Kankakee, Ill.

Mr. Schultetus provides a convenient classification of complainers, and states that in Kankakee few customers have "complaints." Most of the so called complaints are in reality "inquiries" and are from customers who are confused, do not understand how they could use the amount of water the meter registers, or are merely seeking information on a number of things.

Most of these inquiries can be cleared up with a minimum amount of work and effort. Usually the source of the trouble such as a leaky fixture which in almost every case is the toilet, over read meters, etc. is found.

The "Chronic"

The real complainer is a problem and can be placed in the same category

with mosquitoes, chiggers and other pests that plague the human race. This character complains about everything and is in the same general classification with a paranoiac. He is found among the educated, and the ignorant and he can be a banker, lawyer or a ditch digger.

He knows more about the water works business than the people who run it. He knows that water meters run fast and that we deliberately allow them to run fast. He knows his rights as a tax payer and is more interested in "telling someone off" than anything else. He will not listen to reason and in some cases even after he has watched his meter being tested, he is not convinced. He will make no effort to check his water usage or assist the company in any way to help him.

The "Damage Collector"

Then we have his cousin who thinks every corporation is made out of money. He seems to be continually looking for a curb box to trip over or a water ditch to fall into so he can collect damages.

There was one specific case recently when a rather seedy middle aged man came into the office. With the help of another man he managed to get into a chair with apparent great effort and pain. It developed that he fell over one of our valve boxes and appeared to be crippled for life. When asked where it happened, then informed him that we didn't have a water main within two blocks of the place, he then became very angry and hurried out of the office a well man.

How then to deal with these people is definitely a problem as stated above and almost every case has to be dealt with separately. There is no one specific rule to follow.

Safety First Pays Off

We believe that "safety first" applies to complaints as well as accidents and that good public relations is a great asset. We then try to avoid misunderstanding and complaints by carefully reading meters with polite and well trained meter readers. Meters are read monthly to avoid large bills and to discover leaks, vacancies and other irregularities as often as possible. This method costs more than bi-monthly or quarterly billing but it all depends on how much value is placed on satisfied customers, easy to pay water bills, running down complaints, and the reduction of uncollectable accounts and accounts receivable.

The company is also extremely careful of open ditches; high curb boxes and other items discovered in the system are corrected as quickly as possible. When a lawn is excavated it is carefully replaced and grass seed planted.

Every possible effort is made to turn off and on a customer promptly, as well as after hour emergency calls.

The office personnel is courteous and try in every way to give the customers all the individual attention possible. Service cars are equipped with mobile telephones to enable prompt attention at all times.

Brochures have been prepared, which are given to all new comers to Kankakee by the Welcome Wagon lady and "open house" is held at the Pumping Station at which time complete tours are available to the public. The last one more than 2,000 people attended. These people were given phamphlets showing how the water is treated and softened, and explain what soft water is and its value.

Further explanation is provided through literature and newspaper articles on the company's problems, what is being done to improve the facilities keeping all information and statements positive rather than negative.

It is felt that "an ounce of prevention is worth a pound of cure" is definitely true and that possibly thousands of complaints have been eliminated by the safety first methods as outlined.

* * * * *

Lake Forest, Ill.

Mr. Watson dealt more with the type of interested inquiries rather than complaints. He presented an outline of the different types of inquires and how they are handled.

Interested Citizens. The truly interested citizen who desires to know more about the various muncipal functions in order that he may be prepared to be of service on a citizens committee, as a Trustee or Alderman or perhaps a President of a Village or the Mayor of a city.

Reporters. Newspaper reporters or human interest writers that are usually interested only in the unusual or the sensational. These people can be your friends, the few minutes you give to help them get an article may pave the way for future articles containing facts that you wish to get before the public.

Clubs. Clubs that wish a cheap luncheon speaker or want information for a project paper will sometimes create a situation where it becomes necessary to answer at some length either by a short talk before the club or by means of a carefully worded paper for incorporation in the project report. As a speaker, be brief since your audience was trapped by the desire to eat and will not appreciate statistics for dessert. In the case of the club report, keep out of the area requiring technical words since multisyllable words and knitting will not mix.

Schools. The Lake Forrest water department annually speaks before the seventh and eighth grade science and civics classes and before the high school chemistry and physics classes. If you have never had this experience you have never heard inquiries and complaints. Many of which the student's own parents would hesitate to ask.

The Curious. The curious few that must know all of the details first so that they can present themselves as authorities to the next persons they meet or stop to gossip with.

The Intolerant. Then there is the small intolerant group who feel that all municipal officers, employees and department heads are a collection of uneducated, inexperienced, inefficient and arrogant political appointees. Their inquiries or complaints usually take the form of a loud mouthed caustic comment in some large gathering.

Rules for Handling Inquiries

The Lake Forrest water company has instructed its employees, in their handling of inquiries or complaints, to abide by the following advice and rules.

"All of the types of citizens mentioned in the preceding part of this paper are indirectly your employer. Both as citizens and employers they must be treated with utmost consideration for best public relations. In order to best achieve this there are several rules which apply:

1. Listen carefully to a verbal complaint or read carefully a written complaint.

2. Be sure you understand the customer's problem as it affects him.

3. Avoid arguments.

4. Offer to study the complaint as it will affect both the customer and the Municipality.

5. Make notes to avoid the possibility of forgetting any of the details of the complaint.

6. Thank the complainant for taking the time and showing the interest required to make the inquiry, complaint or suggestion.

7. Follow up with a letter or phone call stating your decision or answer and give the reasons therefor. An answer even though it is contrary to the thinking of the complainant is good public relations since nobody likes to be forgotten."

Complaints Divided by Cause and Procedure

Complaints themselves may be divided as to cause and in each case the procedure that is used in Lake Forrest is given.

1. Supply
   a. *Taste, odor and purity.* A sample is taken at the residence of the complainant. The sample is processed in the laboratory and if required the chemical dosages changed to eliminate the complaint. A letter or phone call is made to the complainant stating the results and thanking them for calling the trouble to our attention.
   b. *Failure of water supply.* Notify the police, fire department, city hall telephone girls and hospital. Give them an estimate of the probable outage time.
   c. *Low Pressure.* Thank the informant after getting the address affected. Determine cause and eliminate if possible. Where the cause is insufficient main capacity all customers in the affected area are notified to avoid wasting water and thereby keep the pressure satisfactory for fire protection. As soon as the condition improves notify the customers that unlimited use is permitted. Thank them for their cooperation.
2. Distribution Systems
   a. *Distribution System Breaks.* Valve off the broken area. Notify all customers in the affected area of the cause and length of time the service will be off.
   b. *Distribution System Shut-offs.* Notify all customers that will be affected or provide alternate service. Flush mains and services after the service is returned.
   c. *Dirty Water.* We flush all dead end mains but occasionally get complaints of rusty or dirty water. The main is thoroughly flushed, the water sampled and tested and a report sent to the the customer. In some cases the initial inspection shows that the cause is within the premises of the customer such as the hot water tank or old iron lines carrying too hot water. We then recommend flushing the tank and perhaps replacing the indicated hot water lines.
   d. *Service line failures* are not a part of the responsibility of our Municipality, however we get numerous complaints of loss of pressure, ponds in the front lawn that were not there before, and water squirting out of hot water tanks. We contact a service car by radio who makes the inspection and emergency shut-off and tells the customer that the service line after it leaves the City Water Main is their responsibility and that they should contact their plumber. Nights and holidays additional work is sometimes done to keep the customer supplied with at least cold water for sanitary purposes.
   e. *Inquiries relative to the location of utilities* are handled either by the Building department or the Water department. The Water department keeps a complete card system, indexed by street names and numbers on which is shown the size, material and location of the service line and the shut-off.
   f. *Contractors, architects or owners* inquire as to the requirements for service material, depth of pipe, type of shut-off and box. The answers are provided by giving them a small blueprinted detail. The follow-up is made by the tapper who inspects the service for compliance with the ordinances before making the main tap. He measures the service to get the necessary information for the index cards mentioned above. This service is in most cases appreciated by the owner and damned by the irresponsible plumber.
3. Meter reading and Billing
   a. *Meters over or under read.* Explain how the meter works and that the bill will correct itself at the next reading. If this is not satisfactory provide a corrected bill and if it has been paid issue a refund check.
   b. *Stopped meters* that are estimated for billing. The average of the same Quarter for the past two years is used as a basis for estimating. Change of ownership or size of family is considered in using the two year average as well as the relative rainfall and total water consumption for the entire city.
   c. *Leaking or noisy meters* are cheerfully replaced by a new or reconditioned meter which is sure to record all water passing through it.
   d. *Unread meters.* Meters which have been unable to be read and are estimated for several quarters cause some complaints. Explain to the customer that the company would like to make an appointment to change the meter to a straight reading meter which can be read and reported on a post card provided by the city.
   e. *High billing.* Check meter reading by another reader. If consumption is still high an inspection is made for visual leakage through dish-washers, laundry tubs, fountains, pools, air conditioning, toilet tanks, stop and waste valves and garden sprinkling lines which are above frost line. If this fails a graphic meter is installed which shows the amount of usage per unit of time for 24 hours. Lake Forrest has an ordinance which sets up a method whereby a customer may apply for consideration of a large bill under certain circumstances.
   f. *Lost bills.* Send a duplicate bill and extend the penalty date if necessary.

g. *Penalties.* A penalty is added to the bill if unpaid after the 20th of the billing month. This date is shown on the bill. Customers that pay the net amount of the bill by check on or after the due date are penalized even though the check is dated prior to the due date. The only exceptions are if the posting date on the envelope is prior to the due date or if the bill is paid through a multiple from the bank and the cash is already in our account prior to receiving the multiple statement.

4. New Construction

In order to avoid or at least lessen the number of inquiries relative to new construction the company has taken the opportunity offered by the local papers to publicize the proposed work, pointing out that the construction might inconvenience customers along the streets affected. Before the contractors begin in a certain area letters are written to all of the property owners fronting on that street asking their cooperation during the time of construction. Contractors are required to open traffic on all streets at night unless permitted by the resident engineer to keep them closed. Well marked and lighted detours must be provided during the entire period of construction and clean-up.

Progress Report on Federal Sewage Grants

The Federal Dept. of Health, Education and Welfare, Water Supply and Water Pollution Control Program Section, has released the following report on the administration of the Construction Grants Program under the Federal Water Pollution Control Act (P. L. 660—84th Congress) from program inception to December 31, 1957. $50 million per year is authorized to assist municipalities in the construction of sewage treatment works. To date $95 million has been appropriated for this purpose ($50 million F. Y. 1957 and $45 million F. Y. 1958).

(1) Status of Grant Offers Made and Applications Pending

	Number	Estimated Project Costs (In Millions)	Grant Offers Made or Requested (In Millions)
Grant Offers Made	828	333.7	69.1
Applications In Process	675	506.9	69.5
Aplications Under Preparation	278	98.7	20.1
Total	1781	939.3	158.7

Total applications approved, in process, or under preparation, request grant funds 67 percent in excess of existing appropriations. Present appropriations will support the construction of approximately 1140 projects, as compared to the 1781 projects for which applications have been submitted or are being prepared.

(2) Status of Projects

Projects Completed	47
Projects Under Construction	358
Projects Approved, but not Under Construction	423
Total	828
Total (1950 census) population of applicant communities	17,273,425
Average population of communities constructing projects	20,861

(3) Effect of Projects in the Control of Water Pollution

(a) Sewage Treatment Plant Construction.

Preliminary contract award data for 1957 indicate that there has been an increase of about one-third in the annual rate of construction of sewage treatment works during the first full year of operation under the construction grants program over the five-year annual average for the period 1952 through 1956.

The effect of the Federal grant program on new plant construction is of particular interest. During the period from 1952 through 1956, contract awards for new plant construction represented 48 percent of all contract awards for sewage treatment works construction. However, during 1957, 75 percent of all contract awards for projects receiving Federal grants went toward new plant construction. This marked increase in ratio between new plant and total sewage treatment project construction under the Federal grant program is believed to be indicative of the effect of this program in stimulating the abatement of pollution from communities which have heretofore been unable to proceed with the construction of needed sewage treatment works.

(b) Wastes Removed From Streams.

The first 680* projects approved under this program will, upon completion, provide adequate sewage treatment for a population of 12,017,000. The presence of industrial wastes in the sewage from these communities increases the population equivalent to 13,418,000. Existing treatment facilities in some of these communities reduce the strength of this sewage to a population equivalent of 9,808,000. The 680 grant-assisted projects, however, will reduce the strength of existing sewage flows to 4,944,000—an overall reduction of 63%. These projects will also provide additional waste treatment capacity and serve an ultimate population of 18,156,000.

(c) Miles of Streams Improved.

The first 546* projects approved in 43 States, the District of Columbia, Puerto Rico and Hawaii, will upon completion, reduce the pollution from municipal sewage (including industrial wastes discharged to municipal sewers) in an estimated 6300 miles of streams to a level which conforms with the State Water Pollution Control Plans. This does not include the many miles of lake and ocean shore lines which will be improved through the construction of grant-assisted projects, for which estimates in miles cannot be made.

* Data not yet available for remaining projects.

Charles E. Hughes, Jr., Supt. Decatur Sanitary District

Mr. Charles E. Hughes, Jr., was appointed Superintendent of the Sanitary District of Decatur, Ill., to replace Dr. W. D. Hatfield, who retired on Jan. 31st. Mr. Hughes has been a sanitary and design engineer with Warren and Van Praag, Inc., since 1946. Prior to that time, he served as a Sanitary Corps Officer with service in Panama, Okinawa and Korea and retired with the rank of major.

Mr. Hughes is a graduate of the University of Illinois with a BS degree in engineering with honors and member of Tau Beta Pi and Chi Epsilon. He is a native of Rockford, Ill. He is a member of ASCE, NSPE, and is a registered engineer in the State of Illinois.

In every water works, two problems, one of policy and one of practice are ever present in the matter of . . .

Distribution System Extension*

by RAY MURRAY, Principal Engineer, Nussbaumer, Clarke and Velzy, Consulting Engineer, Buffalo, N. Y.

EVERY COMMUNITY, large or small, which has a water system, will be confronted, sooner or later, with the problem of making extensions thereto. The problems presented by extensions fall into two general categories. First is the problem of the policy or procedure to follow in making extensions, and secondly the problem of mechanics of installing the extension. This paper will deal in generalities as to the policy or procedure in making extensions; but will cover in more detail the mechanics of installing them.

Policy

The "Conservation Law" of the State of New York has the tendency to subdivide water system extensions into two classifications. One class being those extensions to be made within the corporate limits of a municipality or water district. The other class are those extensions to be made outside the corporate limits of a municipality or water district.

In the first instance, the governing body of the municipality or water district has the authority to approve and authorize the construction of any extension within its corporate limits. In the second instance, where the service extension is to be made beyond the corporate limits of the municipality or water district, the Conservation Law requires that an application be made to the Water Power and Control Commission, and that its permission be granted before any extension is made to the desired water service area.

Copies of the New York State rules and regulations for making application for extensions under the jurisdiction of the Commission, may be obtained by writing to the Water Power and Control Commission, 110 State Street, Albany, N. Y.

* A paper presented before the N. Y. Section of AWWA and released for publication in *Water & Sewage Works*.

Engineering Study

Regardless of whether the jurisdiction to make extensions rests with the municipal authorities or with the Water Power and Control Commission, the problems presented in making extensions are the same. In either case an engineering study should be made. This study (excluding the need for storage, pumping stations, etc.) should cover the following basic points:

1. A determination of the present and future water requirements of the area to be served by the extension, including fire demand.
2. The adequacy of the existing water facilities and distribution system to meet the demands imposed by the extension.
3. The integration of the extension into the existing distribution system.
4. The size of pipe, location of valves and spacing of hydrants required to satisfy demands of the proposed extension and any future expansion thereof.
5. Materials to be used in construction.

All too frequently a municipality or water district will contract to make extensions into new areas without first studying the demands of the new extension and its effect upon the existing water producing and distribution facilities. This action often results in an overtaxed system and poor service for all consumers. If a proper study is made previous to the contract for the expansion, the deficiencies of the existing facilities will be apparent, and an intelligent decision can be made as to whether or not the extension is to be made.

Water service extensions frequently are made in a sporadic and haphazard fashion, resulting in a future distribution system containing too many under size pipe and "dead end" pipe lines. Both of these are a constant source of trouble, and finally result in expensive replacement costs to correct the lack of proper planning in the first place. A study should be made prior to making any extension, to determine how the proposed extension can be properly integrated into the present system. Such a study will provide pipe lines of adequate size for anticipated reasonable future growth of the area to be served, and will reduce to a minimum "dead end" pipe lines.

Pipe Sizes

The matter of selecting pipe lines of the proper size to meet the demands of the area being served by the extension is very important. Too frequently a municipality or water district will, through expediency, make extensions using small size pipe lines that are no more than adequate to supply the demands for water. Such a policy is very short sighted. It would be better policy to defer the installation of water service until such time as the area requesting the service is willing or able to install pipe lines of adequate size.

The demand for water service can be observed in any community where water line extensions are being made. It will be observed that as soon as a water line is installed along any street, that street will soon be completely built up while adjacent streets of equal development characteristics, but without water service, will not attract a single home. When a street is built up, the residents immediately demand, not only a good domestic water service, but fire protection service also.

Since water service extensions should provide for fire protection as well as for domestic service, the policy should be to limit the size of pipe to be used to the fire demand rate. The adoption of such a policy will result in pipe lines of minimum size of 6 inch diameter, since pipes of smaller diameter do not have the carrying capacity to support fire flows as required by the National Board of Fire Underwriters.

The selection of materials for an extension should generally conform with those used in previous installations, providing they are adequate for the service. In making extensions to old systems however, one should not avoid adjusting standards to newer and better products.

Installing Pipe

The first thing to be considered in installing pipe lines is the trench excavation, for the quality of work obtained in installing the pipe will depend to a great extent upon the type of excavation made. The trench should be excavated to the necessary line and grade to accomodate the pipe in its designed position. The depth of trench should be such that the pipe has a minimum cover to prevent freezing during extremely low temperatures. Considering the temperature in the latitude of New York State, this would require a minimum cover of at least 3 ft 6 in. A minimum cover of 4 ft 6 in. is preferable. In northern New York State, experience might even dictate more cover.

The width of trench should be such as to permit ample working space for workmen placing the pipe and making the joints. This will require a minimum width of 18 inches for pipe six inches in diameter and smaller. For larger pipes, the most common rule for trench width is: the outside diameter of the pipe plus 12 inches.

Trench Bottoms

There are several types of trench bottom used in laying pipe. The following six methods have been studied and relative strength values determined for the various methods of installing pipe in the bottom of the trench.

A. Flat bottom trench, back fill not tamped.
B. Flat bottom trench, backfill tamped.
C. Pipe supported on blocks, backfill not tamped.
D. Pipe supported on blocks, backfill tamped.
E. Bottom of trench shaped to fit the bottom of the pipe for about 90 degrees, unevenness filled in with sand as required, backfill not tamped.
F. Bottom of trench shaped to fit the bottom of the pipe for about 90 degrees, unevenness filled in with sand as required, backfill tamped.

Method "C", pipe supported on blocks, backfill not tamped produces the greatest load that tends to crack the pipe. This method was commonly accepted 25 years ago, but today it is not recommended. Methods "E" or "F" are ideal, but are too expensive under present day high labor costs. As consulting engineers, we consider method "A"—flat bottom trench, backfill not tamped—to be satisfactory, and more apt to be accomplished in the field. Our designs are based on this method.

The trench should be excavated to a flat bottom to grade of sound earth, which will give the pipe good bearing for its full length. If the trench should be over excavated in depth, it should be built back to grade with satisfactory material, properly compacted. Bell holes should be formed at each joint, to permit room for properly constructing the joint. If rock or boulders are encountered in the excavation they should be removed so as to provide 6 inch clearance of the pipe. The extra depth excavation should be built to pipe grade with satisfactory material, properly compacted.

Placing The Pipe

After the trench has been properly excavated to receive the pipe, then the pipe should be lowered into the trench and installed piece by piece. Proper implements, tools and facilities for satisfactory, safe and convenient prosecution of the work should be at hand. All pipe, fittings, valves and hydrants should be carefully lowered into the trench piece by piece by means of power equipment, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to pipe or pipe coatings. Under no circumstances should the pipe or accessories be dropped or dumped into the trench.

It is advisable, before lowering and while suspended, to inspect each pipe for defects and ring with a light hammer to detact cracks. Care should be observed to remove all foreign matter or dirt from the inside of the pipe and accessories before they are lowered into the trench, and to keep them clean during and after laying. Before laying pipe, all lumps, blisters and excess coal-tar coating shall be removed from the bell and spigot ends of each pipe; the pipe ends should then be wire-brushed and wiped until clean and dry, and kept clean until joints are made.

After placing a length of pipe in the trench, the yarning material for the joint shall be held around the bottom of the spigot so that it will enter the bell as the pipe is shoved into position.

The spigot should be centered into the bell, the pipe forced "home" and brought into true alignment; it should be secured there with earth carefully tamped under and on each side of it, excepting at the bell holes. Care shall be taken to prevent dirt from entering the joint space. At least four lengths of pipe should be in place ahead of each joint before it is poured. The pipe should always be laid with bell ends facing the direction of laying.

All pipe laying should be done in trench free from water. When pipe laying is not in progress, the open ends of pipe should be closed by approved means and no trench water should be permitted to enter the pipe.

Pipe Joints

The pipe joints may be of either lead, sulphur compound joints, or mechanical bolted joints. The method of making each will be briefly described:

For lead and sulphur compound joints a yarning material is required. The yarning material most frequently used is square braided hemp or jute, or rubber gaskets, which have recently become available. The material should be free from oil, greasy substances, or tar, and should be thoroughly sterilized before using. If the material is sterilized by the manufacturer, it should be so handled as not to be contaminated before being placed in the pipe joint.

Wherever a single strand of braided hemp or jute is required in jointing, the material should be cut to such length that the strands will reach entirely around the pipe with ends overlapping not less than 2 inches. Wherever more than a single strand is require, it shall be cut to sufficient length so that the ends meet without causing overlap. Those ends should meet on opposite sides of the pipe and not on the top or bottom. Successive strands of yarning material, as required, should be driven "home" separately. Each strand should be thoroughly packed and hammered into the joint with suitable yarning tools.

After yarning, sufficient space should be left in the bell to receive the joint material. For lead joints, on pipe 24, 30 and 36 inch pipe, a space not less than 2 1/4 inches in depth shall be left in the bell to receive the joint material. A space 3 inches deep is left for pipe larger than 36 inches. For sulphur compound joints, a space not less than 2 1/2 inches in depth shall be left in the bell for pipe whose nominal diameter is 24 inches or less, 2 3/4 inches in depth for 30 and 36 inch pipe, 3 1/2 inches for 48 inch pipe and 4 inches for 54 and 60 inch pipe.

For both lead and sulphur com-

pound joints, proper size joint runners should be used. The joint runner should fit snugly against the face of the bell, and the outside of the pipe. For lead it can be dammed with clay at the pouring gate to provide for filling the joint even with the top of the bell. For sulphur compound a suitable funnel shaped metal pouring gate, extending not less than 3 inches above the bell, should be adequately clayed to the joint runner, and filled with compound. The solidified compound in the pouring gate shall be cut off flush with the top of the bell, or broken off flush with the top of the joint. With either lead or sulphur compound each joint should be made with one continuous pour of metal or compound while the material is at the proper temperature.

Sulphur compound joints are not to be caulked. If the joint is defective, it shall be cutout and entirely remade. Lead joints should be caulked after cooling to the temperature of the pipe. They should be caulked by means of pneumatic tools, or by hand tools, by competent, experienced workmen until thoroughly compacted, making watertight joints without over-straining the bells.

Mechanical Joints

The mechanical joint is coming into wide use, due to the simplicity of making the joint and its watertightness. The joint has four parts: a flange cast integral with the socket or bell of the pipe; a rubber gasket fitting a recess in the socket; a gland, or follower ring, to compress the gasket; and the bolts and nuts for tightening the gland. The mechanical joint is simple to asemble. The gland, followed by the rubber gasket, is placed over the spigot end of the pipe, the pipe is inserted into the bell and shoved "home". The gasket is then pushed into position so that it is evenly seated in the socket. The gland is moved into position against the face of the gasket. Bolts are inserted and made finger-tight. Then, with an ordinary ratchet wrench, the bolts are tightened up. Where there is danger of the workmen pulling the bolts too tight, a tourque wrench can be used in lieu of the ratchet wrench.

A new O-Ring Type rubber joint has come on the market for cast iron pipe. Asbestos-cement pipe uses an O-Ring and slip joint coupling. Concrete pressure pipe uses a similar rubber joint and clamps to draw the joint tight.

Fittings & Valves

Pipe fittings should be installed in the same manner as the pipe, except that all tees, plugs, caps and bends exceeding 22 1/2 degrees should be securely anchored by concrete thrust backing. The backing should be placed between solid ground and the fitting to be anchored. The backing should be so placed that the pipe and fitting joints will be accessible for repair.

Valves for use in water pipe lines should be American Water Works Association standard. There are several manufacturers of this quality valve, and the make of valve should be left to the selection of the owner. From a maintenance standpoint, it is advisable to standardize on one or two, and not more than three makes in any municipality, instead of having several makes in the same system. Valves should be selected so that they all open by turning in the same direction.

Before valves are placed in the pipe line they should be thoroughly inspected to see that they are in first class working shape. Care should be observed to see that the valve is set true and plumb. The mechanics of making the joint connections to the pipe would be the same as described under pipe installation.

Each valve placed in an underground pipe line should have a cast iron valve box cover. The valve box should be firmly supported, and maintained centered and plumb over the wrench nut of the gate valve, with box cover flush with the surface of the finished pavement or surrounding ground level.

Backfilling

Backfilling of the pipe trench should be done in two operations. One being the procedure for backfilling at the pipe zone, and the other the procedure for backfilling above the pipe zone.

Backfill at the pipe zone should be done with select material, free from rock or boulders, to a depth of 6 inches over the top of the pipe for diameter of 10 inches or less, and not less than 6 inches above the center of the pipe for sizes 12 inches in diameter and over. The backfill material should be deposited in the trench simultaneously on both sides of the pipe for the full width of the trench.

Backfill above the pipe zone should be made with materials free from large stones, boulders, or similar materials, which may injure the pipe. If the excavated material is of suitable quality for backfill, the backfill may be done with power equipment. If it is important that there be no settlement, such as along highways where it is desired to resume vehicular traffic as soon as possible, or replace a permanent pavement, the backfill should be made in 6 inch layers with each layer thoroughly compacted, or if conditions are favorable the trench may be flooded. The backfill around the valve box should be made by hand and thoroughly tamped for the full depth of the exacavation.

Hydrants

Hydrants are usually spaced at about 500 ft. intervals, in accordance with the Fire Underwriters' Organization's recommendations. They should be located in a manner to provide complete accessibility, and in such a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized. The hydrants should stand plumb. Those with one pumper nozzle should be set with the nozzle normal to the curb. Other type should be oriented as directed by the Fire Marshall of the community.

Each hydrant should be connected to the main with 6 inch cast iron branch controlled by an independent 6 inch gate valve.

Where hydrants are placed in impervious soil, a drainage pit, two feet in diameter and two feet deep should be excavated below the hydrant and filled compactly with coarse gravel or broken stone mixed with coarse sand, under and around the bowl of the hydrant and to a level of 6 inches above the waste opening. No hydrant drainage pit should be connected to a sewer.

The bowl of each hydrant should be well braced against unexcavated earth at the end of the trench with stone slabs or concrete backing, or it should be tied to the main with suitable rods or clamps.

The hydrant should be thoroughly cleaned and inspected before placing.

Inspection & Records

Water main extensions may be done either by "contract" or by the municipality's own personnel under "force account" work. If the work is done by contract, plans will be prepared for the work previous to construction, and usually, an inspector assigned to the work. In addition to seeing that the work is properly installed, the inspector would be required to keep an accurate record of the location of the pipe line, and all accessories, such as; fittings, valves, hydrants, service connections, etc. These data should be recorded in a "field book", with sufficient sketches, properly dimensioned so that anyone can use the data in the " field book" to relocate the individual items of

work in the future. All location dimensions should be tied to permanent surface structures, such as pavements, buildings, hydrants, etc.

When the work is completed, the original plans of work should be revised to conform with the work as installed. These revised plans should be stamped "Revised Plans", and permanently filed for future reference.

In addition to the "Record" plans, many municipalities have a set of plates on drawings made of their water system, usually to a scale of 1 inch equals 50 ft, and all data as to size of pipe lines, location of valve, hydrants, fittings, etc. are shown on the plates. Such a file of drawings is invaluable if kept up to date.

Where work is done by the municipality's own personnel, one individual should be assigned the task of keeping a record of the work as it is installed, in the same manner as outlined for work done by contract. A "field book" record should be kept, and later this information should be transferred to permanent record drawings.

What Price Water?

This provocative question is the title of a booklet now available from the American Water Works Association.

Illustrated by drawings with accompanying 1940 and 1957 price tags of the various everyday items graphically illustrate how costs have risen 100 percent or more during this period.

The text also asks and answers several leading questions, such as: What is water worth?, How can you price an unpriceable?, Do you pay for water alone?, Is the price too high, and What will your share of the new price be?

Further information as to quantities and prices for the booklet and special imprints can be obtained from the American Water Works Assn., 2 Park Ave., New York 16, N. Y.

New Edition of "Water Supply and Treatment"

National Lime Association has just published the 8th revised, enlarged edition of its "Water Supply and Treatment" book. The new 221-page edition is now entitled "Hoover's Water Supply and Treatment," in honor of Charles P. Hoover, internationally known water plant chemist, who was the author of the first seven editions. Mr. Hoover, also referred to as the Dean of the Water Works Chemists, died in 1951, shortly after he prepared the 7th edition.

The new author is Merrill L. Riehl, a former protegé of Mr. Hoover and presently Superintendent of Purification and Chief Chemist of the Mahoning Valley Sanitary District, Youngstown, Ohio. In addition, Mr. Riehl serves as a consultant for water, sewage, and trade waste treatment plants in Ohio and the Middle West.

Extensive revisions and additions have been included in the 8th edition. A chapter on fluoridation of water supplies has been added, and the chlorination section has been expanded to include new chlorination equipment. Latest methods for determining hardness, calcium and magnesium content, bacteria, and calcium carbonate stability were also included. In addition, revisions were made covering disposal and reclamation of water softening sludge, recarbonation, taste and odors, and silica removal with dolomitic lime. The new edition contains more than 100 illustrations, many of which are multicolor.

Copies of the 8th edition may be obtained from the National Lime Association, Washington 5, D. C., at $2.00 per copy, plus $0.12 postage.

Civil Engineers' Data Book

Volume II of Elwyn E. Seelye's comprehensive "Data Book for Civil Engineers" is now available in a third edition, published by John Wiley & Sons. Dealing with specifications and costs, this thoroughly revised volume covers nearly every type of building and heavy construction.

New material includes special specifications for covering foundations, warnings termed "Red Lights" relating to specifications writing, riprap specification suggestions for cathodic protection, and a suggested form of agreement between engineer and client. At the same time, the specifications have been extended and revised to cover such matters as recommendations for painting and wood preservation.

In one section, Mr. Seelye has added economic studies of various construction costs. Among the other additions are comparison of treatment plant costs, highway bid indexes, economic study of flexible vs. concrete pavements, comparison of hospital costs, and an analysis of building costs. These and additional changes have been rendered in accordance with the *Engineering News-Record* Cost Index which has also been brought up to date.

The third edition of "Data Book for Civil Engineers," Volume II, contains 566 pages and is priced at $20. Volume I of the set, dealing with design, contains 521 pages and is priced at $16.75. Volume III, covering field practice, contains 394 pages and is priced at $7.50.

Sheboygan, Wis., Dental Survey Shows Effect of Water Fluoridation

Jerome C. Zufelt, Supt., Board of Water Commissioners, Sheboygan, Wis., has supplied detailed data on the dental survey records for each year since fluoridation of the water supply began in that city in 1946. These data indicate a continuing improvement in the dental condition of children in that city since 1946; there has been a decrease in D.M.F. rate each year. The per cent D.M.F. improvement since 1945 is as follows:

	No. Children Examined	D.M.F. Rate	% D.M.F. Improvement Since 1945
Kindergarten—Deciduous Teeth			
1945	416	4.80	———
1957	630	1.62	66.3%
4th Grade—Permanent Teeth			
1945	614	3.03	———
1957	604	1.50	49.5%
7th, 8th, 9th Grade—Permanent Teeth			
1945	1877	8.54	———
1957	1261	4.31	50.4%

Pickups

From Purdue's *"Sanitary Engineering News"*
Don E. Bloodgood, Editor

In the control of chiggers, toxaphene at 2 lbs per acre is effective for 14 weeks.

A new method for the micor-determination of the cupric ion (in water) by the use of an ezyme has been reported.

Elimination or reduction of non-revenue water losses is the purpose of determining . . .

Distribution System Leakage

by E. E. BOLLS, JR., Principal Engineer
Black & Veatch, Engineers, Kansas City, Mo.

IN MANY WATERWORKS systems, the feeling prevails that leakage, like poverty, death, or taxes, is always with us. Like many statements containing a modicum of truth, this one can lead to wasteful operations if taken literally.

For the purposes of this paper, leakage is defined as the difference between the quantity of water discharged into the system and the summation of the quantities measured by customer meters. It is true that a number of cities are not 100 percent metered and some cities operate under flat-rate schedules and have no meters. In such cities the reduction of leakage is a "hit-or-miss" proposition with a limited chance of success.

Par for the Course

In every water system there are numerous leaks that could be eliminated by a concentrated and continuing program of leak detection and repair. However, for each system there is a point of diminishing return on such a program and management, in each system, should determine the amount of leakage that will be tolerated. It can be stated safely that the vast majority of water systems could afford to expand their leakage control programs many times without reaching the point of diminishing return.

A rough yardstick to measure the efficiency of leakage control programs is provided by statistics from other cities. In June 1953, the *AWWA Journal* presented the results of a survey of more than 900 water utilities serving populations of at least 10,000. Complete or practically complete answers were returned by 416 cities.

The answers to the question of percentage of production sold varied widely, but gave good indication of the percentage of unaccounted for water. The raw information is somewhat misleading, as a number of the cities were not fully metered or did not record free water service. Therefore, the quoted percentage of production sold indicates more unaccounted-for water than is actual in such cases.

The median figure for all cities reporting was 84 percent of production sold. Thus, the median of unaccounted-for water is indicated to be less than 16 percent.

Louisiana cities reporting included:

1. Baton Rouge, 100 percent metered, 12 percent unaccounted-for.
2. East Jefferson, 100 percent metered, 20 percent unaccounted-for.
3. New Orleans, 100 percent metered, 45 percent unaccounted-for.

The New Orleans figure includes free water and a free water allowance for sewerage purposes. After correction for these items, the New Orleans system shows 35 percent unaccounted-for.

To supplement the results of the AWWA survey, a group of typical cities served by Black & Veatch in recent years is included in Table 1. The indicated median unaccounted for is 19.6 percent. The best showing in this group is by the Kansas City Suburban Company, which serves approximately 80,000 people. The low percentage unaccounted-for (9.1) is due in part to the age of the system, as most of the mains and services have been installed since 1940. It is probable that Cincinnati and Milwaukee are more representative of the older cities having excellent leakage control programs. The experience of these two cities shows that unaccounted-for water can be economically limited to 10 to 15 percent.

TABLE 1

Unaccounted-For Water in Selected Cities

City	Year of Report	Per Cent Unaccounted-For
1. Atlantic, Iowa	1954	21.7
2. Carthage, Mo.	1954	25.3
3. Chillicothe, Mo.	1948	17.0
4. Cincinnati, Ohio	1954	15.0
5. Fargo, N. Dak.	1953	22.9
6. Paragould, Ark.	1949	15.9
7. Neosho, Mo.	1956	48.0
8. San Antonio, Tex.	1954	19.4
9. Kansas City Suburban	1954	9.1
10. Kansas City, Mo.	1955	19.9
11. Natchez, Miss.	1956	19.9
12. Milwaukee, Wis.	1954	10.1

Irreducible Minimum

Unaccounted-for water results from leaks in the distribution system and under-registration of customer meters. Therefore, it is desirable to evaluate the probable meter loss in each system in order to establish a program of meter maintenance and leak repair.

An interesting article was contained in the *AWWA Journal*, Vol. 39, (1947), concerning the reduction in meter accuracy compared to length of time in service. This paper, by G. L. Williams of the California Water Service Company, presents a scientific approach to the determination of the optimum period for routine testing and maintenance of meters.

The studies for this paper found that the average meter accuracy declined very slightly for the first seven years of service. In subsequent years, the reduction in average meter accuracy was much greater, as shown in Table 2. From these studies and

Ed Note: Mr. Boll's paper was presented before the Louisiana Water & Sewage short school held at Louisiana State Univ., Baton Rouge, La. It is published by permission of the Extension Div. of LSU.

by a comparison of revenue lost to cost of meter repairs, it was determined that the optimum period for meter reconditioning was about nine years. The optimum period would, of course, vary with each city, depending on water rates, quality of water, and cost of meter repair program.

In addition to the loss in accuracy resulting from age in service, even new meters will seldom register extremely small flows caused by drips from household fixtures. Therefore, it is estimated that customer meter loss will average 3 percent even with a meter repair program having a 9-year cycle.

In many cities, meters are allowed to remain in service until they stop. In these cities it is proable that the percentage lost through customer meters is extremely high.

A further measure of the "irreducible minimum" leakage can be made by an analysis of the miles of distribution mains in service. The previously mentioned AWWA survey showed that Baton Rouge had the equivalent of 155 miles of 8-inch pipe in service and East Jefferson had the equivalent of 116 miles of 8-inch mains. Using the allowable leakage formula contained in the AWWA pipe laying specifications, the theoretical initial distribution system leakage would be approximately 0.5 percent of production for Baton Rouge and 0.7 percent for East Jefferson.

Because these limits of leakage are for new construction and include no allowance for leaks at corporation cocks and service lines, the "irreducible minimum" loss from under- registration of meters and small leaks in the distribution system is about 5 percent.

Results of Leakage Control

It is apparent that most water systems reduce the unaccounted-for water to a range of 10 to 15 percent of production. However, as a result of low water rates and a past history of abundant sources of supply, many systems have made no concentrated and continuing efforts to achieve such a degree of control of leakage.

For the past decade, cities all over the nation have experienced (a) accelerated demands for water, (b) rising costs of construction and operation, and (c) less attractive sources of supplementary supply. As a result of this sequence of events, the water industry cannot continue to tolerate wasteful operations.

To evaluate the possible results of a leakage control program, consider a city having an average daily water production of 10 mg and assume the unaccounted-for water amounts to 25 percent of production. It is also assumed that 6 percent results from under-registration of meters and 19 percent is caused by system leakage.

TABLE 2

Effect of length of Service on Meter Accuracy

Length of Service, years	Average Meter Accuracy, %
7	99.5
8	99.0
9	98.0
10	96.0
11	93.0

Following a program of meter maintenance, leak survey, and leak repair, it is assumed that the meter loss is reduced to 3 percent and system leakage reduced to 12 percent for a total unaccounted-for of 15 percent. Using the average cost of chemicals and power for pumping as experienced at New Orleans and Shreveport, the following would be obtained:

Annual saving in power and chemical cost (365 x 0.7 mgd x $20 per mg)	= $ 5,110
Annual increase in metered sales (365 x 0.3 mgd x $200 per mg)	= $21,900
Saving in plant investment (0.7 mg x $250,000 per mg)	=$175,000
Equivalent annual saving ($175,000 x 0.04)	= $ 7,000
Total annual saving in reduction of unaccounted-for water from 25 to 15 percent	= $34,010

Establishing the Program

The first step in establishing a leakage control program is an accurate and realistic determination of unaccounted-for water. This should be based of the difference between production and metered consumption, with no estimates included for unmetered services, water used for street flushing, fire fighting, or water used for flushing of sanitary sewers. Meters should be provided on all services, including various locations allocated for filling street cleaning equipment, and these meters on free services should be read along with the other customer meters.

The Venturi or other type of master meters on the source of supply should be checked at least once each five years. A manometer check between the leads of Venturi or orifice meters will provide a check of the indicating and recording mechanism. A pitometer should be used to check propellertype meters.

After the master meters are checked, a period of one to two years of record is required to obtain an accurate determination of unaccounted-for water. This situation is a result of staggered billing and makes it necessary to average the percentages of a number of billing periods in order to obtain a realistic answer.

If the unaccounted-for water is 15 percent or less, the leakage control program is considered to be adequate but should be continued to limit leakage in future years to the 15 percent level.

If the unaccounted-for water exceeds 15 percent, the annual cost of that quantity above 15 percent may be computed as previously described, but using costs of chemicals, power and plant investment that are applicable to the individual system. It would appear reasonable to include a sum equal to one-half the indicated saving in the annual budget plus the previous year's budget figure for meter maintenance and leak detection and repair. It is suggested that this sum be separated into meter maintenance and leak detection and repair. The allocation to meter maintenance should be adequate to establish a 7- to 9-year cycle of testing and repair. The balance of the fund would be allocated to the detection and repair of leaks.

Immediate results should not be anticipated. The unaccounted-for water should be evaluated each year and the budget figure adjusted accordingly.

Locating Leaks With System Personnel

If a system map showing elevations at each fire hydrant is not available, the preparation of such a map should be the first item of work. The map should be drawn in ink on linen so that numbers of prints can be made. The elevations should be accurate to the nearest 0.5 foot.

After the map is completed, a program of hydrant pressure tests should be initiated. For best results, these pressure test should be made between 9:00 PM and 5:00 AM in winter months. The hydrants should not be flushed, as the resulting surges would influence the pressure readings. The work done each night should be carefully planned to cover as large an area, approximately square in shape, as possible. The pressure at each hy-

drant should be converted to hydraulic gradient and plotted on the map with different colors representing pressures measured on the same night.

Hydraulic gradient contours may then be drawn. The slopes of these contours are very helpful in locating major leaks. As a secondary benefit, these contours will indicate valves that are closed in the system. To obtain accurate results, the pressure gages should be checked at regular intervals and pumping heads should be maintained at a uniform level during the tests.

If the hydraulic contours indicate considerable flow in a particular main, the location should be spot checked to determine whether the indication is a leak or a heavy nightime load. If a leak is indicated, inspection of adjacent sewers will sometimes aid in spotting the location. Audiophones or other type leak detectors are also valuable once the leak is isolated within one or two blocks.

The foregoing cannot be expected to locate very small leaks. However, the general experience, in cities having 25 percent or higher unaccounted-for water, is that there are a number of large leaks. A city in Mississippi lists more than 1 mgd for a year through a break in a 6-inch pipe. The 6-inch pipe broke beneath a watercourse at a location less than 100 feet from its connection with a 24-inch main. This leak was discovered when extreme low water in the stream allowed turbulence to reach the surface. Pressure tests would have found this leak quite easily.

Leakage Surveys

A number of cities supplement their leakage control programs at regular intervals by employing specialists to perform leakage surveys. These surveys are based on a series of measurements with pitometers to determine the amount of water entering the system and the distribution of flow throughout the system. Such a survey would have the following functions:

1. Provide an independent check on the accuracy of master meters.

2. Check large industrial meters for accuracy by independent flow measurement.

3. Measure the distribution of the night rate of flow, almost block by block, so the location, as well as the amount of leakage, can be determined. Whenever these tests show abnormal flows, the leaks can be located by audiophones or similar equipment.

In conclusion, the cheapest source of supplementary supply is available from the reduction of leakage in the system. The most painless source of addition revenue is a meter maintenance program geared to limit customer meter loss to about 3 percent.

If the system's unaccounted-for-water exceeds 15 percent, leakage control measures should be started immediately.

W. D. Hatfield Retires

Dr. W. D. (Hap) Hatfield retired on Jan. 31st, 1958 as Superintendent of the Sanitary District of Decatur, Ill., a position he had held since 1924. Dr. Hatfield is currently vice-president of the Federation of Sewage & Industrial Wastes Assn.

A native of Illinois and graduate of Illinois College at Jacksonville, with a M.S. and Ph.D. from the Univ. of Illinois, Dr. Hatfield has had a fruitful experience in the field of water and sewage treatment. During his graduate work, he was an assistant chemist and bacteriologist of the Illinois State Water Survey from 1915-1918. In 1918 and 1919, he served as a 2nd Lt. in the Sanitary Corps of the U. S. Army. For two years thereafter, he was Asst. Prof. and Professor of Organic and Physical Chemistry at Montana State Univ. In 1921, he became Supt. of Filtration of the Highland Park, Mich., Water Plant, taking on the assignment before the construction was finished.

Dr. Hatfield's honors and accomplishments are many. The Federation of Sewage & Industrial Wastes Association has named, in his honor, the William D. Hatfield Award for the best annual operating report. He has served as President of the Central States Sewage & Industrial Wastes Assn. in 1945. He has received the Thomas Fitch Rowland prize of the ASCE and the Rudolph Hering medal of the San. Eng. Div. of ASCE and in 1953 he received the Charles Alvin Emerson medal from the Federation. Dr. Hatfield's long work on the Standard Methods for the Examination of Water, Sewage and Industrial Wastes led him to be nicknamed "Standard Methods" Hatfield on many occasions. The Federation is deeply indebted on three editions of the Standard Methods.

The Illinois Digester had this complimentary comment about Dr. Hatfield's service. "Since the Illinois Sewage Works operators Group was first organized, Dr. Hatfield has been an active and extremely helpful participant. His valuable experience and knowledge of sewage treatment have always been available to all Illinois operators in the annual conferences and sectional meetings. His friendly counsel has been a highly important factor in the advancement of sewage treatment in Illinois, as nearly every operator can testify from personal experience." There are other persons in this field of endeavor who can also testify from experience to Dr. Hatfield's inspiring guidance, particularly the men who worked under him at Decatur, one of whom is the Editor of this magazine.

In addition to his service in the technical organizations to which he belongs, Dr. Hatfield was president of the Decatur Council of Boy Scouts in 1939, from which he says he "progressed to the position of scout leader." Dr. Hatfield has also been president of the Decatur Engineers Club, and chairman of the Decatur City Planning Co.

As to immediate plans, Dr. Hatfield will serve the Federation as Vice President and President, travelling throughout the country to various meetings. His plans thereafter are not complete at the present time.

Dr. Hatfield's successor in Decatur is Mr. Charles E. Hughes, Jr.

Water & Sewage Works Operators Personnel Placement Service

The Florida Water & Sewage Works Operators Assn., has established a placement service to aid interested personnel in securing positions.

The placement service offices maintains a list of available certified operators, and has adopted the policy of making no charge to either party concerned with filling the position available.

Adress all inquiries to Mac Grossman, Director, Placement Service, 369 Granello Ave., Coral Gables, Fla.

For the proper operation of a pump station it is desirable to know a simple method of checking

Pump Efficiencies *of centrifugal pumps*

by H. E. BECKWITH, District Manager, The Pitometer Associates in Pittsburgh, Penna.

WITHIN the past third of a century the slow-moving steam-driven piston pump has largely been displaced in the water works industry by the motor- or turbine-driven centrifugal pump.

This minor revolution has brought new problems for the operator because, unlike displacement pumps, centrifugal pumps are designed to operate under rigidly fixed conditions. Any appreciable variation from these fixed conditions will result in a decrease in efficiency. Just because a centrifugal pump will pump water does not constitute proof that it is doing a satisfactory job. It not only should pump water, but it also should do it with the maximum possible efficiency. Some elementary knowledge of how a centrifugal pump operates may be helpful in understanding how this may be achieved.

At some time in his life every boy ties a horse chestnut, or similar object to the end of a string. By whirling it about his head he builds up enough velocity to send the chestnut soaring into the air when the string is released. The principle of building up velocity in that chestnut by whirling is the same principle used in the design of a centrifugal pump. The water enters the pump through the suction inlet, is seized by the vanes of the impeller, and spun until it is rotating at terrific velocity.

Since pressure and not velocity is chiefly desired, the pump is so designed that by gradually slowing down this velocity in the casing, the energy stored in this rapidly moving water is almost entirely changed to pressure. The speed of the chestnut rests upon two factors—the length of the string and the number of revolutions made within a specified period of time. The velocity, and therefore the resulting pressure, imparted to water by a centrifugal pump also rests upon the same two factors—the radius of the impeller and the number of revolutions per minute which the impeller makes.

There are, of course, practical limits to both the speed and the diameter, so that it is not always possible to secure the full desired pressure with one pump. If not, the water is passed through two or more pumps in series, and each pump raises the pressure part of the total desired amount. Sometimes these two or more pumps are built in one pump case, in which instance each pump is called a "stage." As electrically-driven centrifugal pumps operate at fixed speeds, there is always one head under which a pump will operate most efficiently. Right here it will not hurt to repeat that any material deviation from the condition will result in decreased efficiency.

Typical Performance Curves

Figure 1 is a typical centrifugal pump curve, used for illustration during the discussion. Similar curves are available from the manufacturer for all medium-sized and large pumps. On small pumps it is not customary to furnish such performance curves.

It will be noted from an inspection of the specimen curve that the greatest efficiency for this particular pump (about 75 percent) is secured when the head is about 155 ft and the discharge rate is about 1,300 gpm. Also, as the head is materially increased or decreased from the optimum head there is a large change in the pumping rate and a considerable drop in efficiency. A great deal has been done in the effort to widen out the "peak" of the efficiency curve into a "plateau" so as to give high efficiencies under a wider range of operating conditions.

Proper Head A Must

It is highly important when selecting a pump to be certain that the

head is properly chosen. It is not accurate to take the difference in elevation between the clearwell and the reservoir or tank into which the water is pumped as the total pumping head. To this must be added friction losses, and in the instance of very low-head pumps there must also be added velocity head. To illustrate how important this friction head can be, if we have figured on the pump whose curve is given in Figure 1, and if we are pumping through two miles of 16 in. main, the friction loss will add about 18 ft. to the pumping head, making it 173 ft. At this head (see Fig. 1) the pumping rate will drop to 1,000 gpm and the efficiency to 70 percent.

Furthermore, the pump is operating on a very critical part of the curve, where a slight increase in pumping head—caused by tuberculation in the main or by any other reason—would cause a precipitate drop in both the efficiency and the pumping rate. It also illustrates what can happen to a pump after installation when the pumping head has been increased above the head for which it was designed. As it is the nature of unlined iron and steel mains to tuberculate, with a constantly rising friction loss, this is an important consideration.

This can be illustrated in another way. Suppose that we are in the market for a 1,000-gpm pump operating against a total head of 173 ft, and the pump whose curve we have been using has been submitted for consideration—it might be. This pump would not be considered a good "buy" to operate under these conditions. In the

Ed. Note: Some years ago, Mr. Beckwith wrote an article on centrifugal pumps, their selection and checking. That article was published in several editions of the Reference & Data Number of Water & Sewage Works. At the request of the editors, Mr. Beckwith has revised and brought the article up to date.

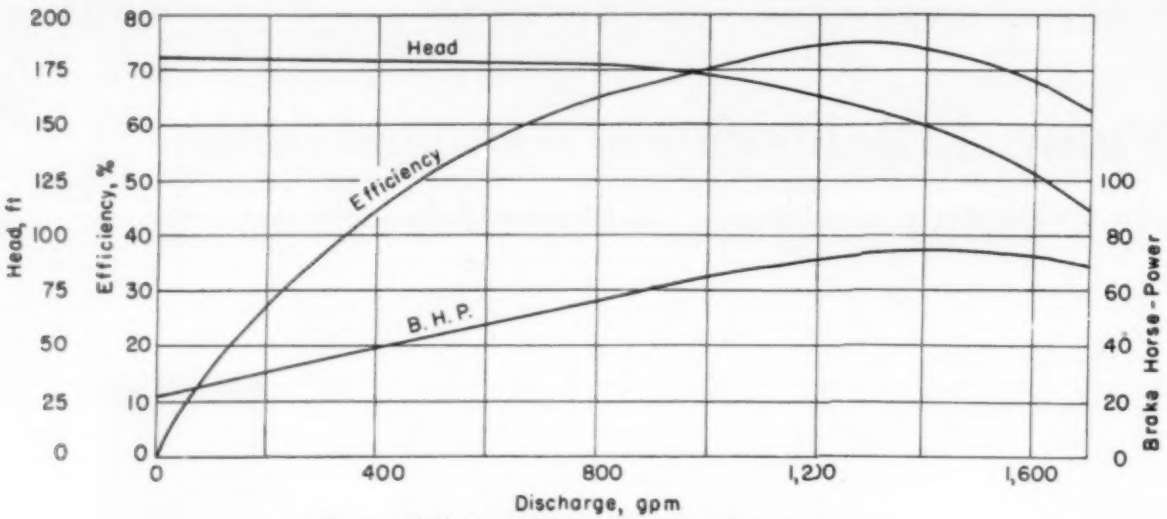


Fig. 1—TYPICAL centrifugal pump performance curves.

first place, it will be noted that the efficiency of 70 percent is much below the maximum efficiency of 75 percent.

But even more important, perhaps, is the fact that the pump at 173 ft head is operating under critical head conditions. An increase of only about 8 ft (or less than 5 percent) in the pumping head would bring the head to the maximum which the pump can create—in other words, to the "cut off" point. This means that an increase in the head of only 8 ft (about 3½ lb) would decrease the pumping rate from 1,000 gpm to 0 gpm. Moreover, an increase of only 3 ft in head would cause a drop of 200 gpm in the pumping rate.

On the other hand, when working in the most efficient range of the pump a change of 3 ft in the head would only cause a variation of 30 to 40 gpm in the pumping rate, and the efficiency is practically unaffected.

It follows, therefore, that one should buy a pump within the range where the efficiency curve is as *flat* as possible and the head curve is as *steep* as possible. In this connection a word of warning is not amiss. By making the vertical scale of the curve less than is customary, a much flatter *appearing* efficiency curve can be secured. Therefore, in comparing the performance curves of pumps one should be sure that they are plotted on comparable scales. The author has known curves with reduced vertical scales to be submitted where he felt sure that the scale was deliberately reduced for the purpose of deception.

More Flow, But Less Efficiency

Only too often in the revamping of a plant, efforts are made to re-use as much of the old equipment as possible. It may be assumed that if the old pump will handle 1,300 gpm against 155 ft head it should have less trouble pumping the same amount from the river to the settling basin against a head of only 40 or 50 ft. This is so. In fact, the curve shows that it will pump much more than 1,300 gpm at the lower head. The curve does not go out that far, but it goes far enough to show what would happen, not only to the pumping rate but to the efficiency as well. The pumping rate goes up, but the efficiency goes down—yes, way down.

Reducing the head has a tendency to cause a pump to "run away," much as an automobile would run away down hill, when the going becomes easier, if the throttle were not closed to compensate for the decreased demand for power. This running away of the pump sometimes overloads the motor so that it runs hot. To prevent this, the head is often artificially increased by closing a valve on the outlet side of the pump. This decreases the load on the motor and brings the pumping rate back to normal. But it burns up a great deal of power needlessly, as the closed valve destroys part of the head generated by the pump and only part of the work actually performed is effective. Installations such as this are known where the installation of a new pump saved more than enough power in one year to pay the entire cost of the new pump and motor.

But it is not always necessary to buy a new pump just because the head has been reduced. The pressure generated by a constant-speed centrifugal pump can be cut down by reducing the diameter of the runner. If the reduction in head is moderate, the manufacturer can advise how much will have to be machined off the outside of the present impeller so that it will pump efficiently; or at a slight expense he will furnish a new impeller for the changed conditions.

It is sometimes, but not always, possible to secure a larger impeller to efficiently handle increased heads, but in this case the motor is likely to be overloaded.

If the revolutions of any centrifugal pump are increased the head which that pump will generate will be increased. This explains why a certain pump gave a wire-to-water efficiency of only 40 percent. This pump was designed for use with a gasoline motor and to operate under the existing head conditions at a speed of 1,400 rpm. Eventually electric power became available, the pump was connected to an electric motor, and the speed was increased to 1,800 rpm. This, of course, increased the head generated by the pump itself, with the result that it was working against only a portion of its design head and the efficiency was, consequently, very low.

Some Odd Cases

A somewhat similar condition was found several years ago when a 4-mgd installation designed to work against a head of 100 lb was found to have been connected in series to a 5-mgd pump designed to pump against 50-lb pressure. This gave an installation with a design head of 150 lb, but the actual head was still about 100 lb. The output was thereby increased to approximately a 6-mgd, but the efficiency decreased to the point where it was only slightly above 40 percent. New and properly designed equipment brought the wire-to-water ef-

TABLE I

U.S. Gallons of Water Delivered per Kilowatt-Hour Against Various Heads on Theoretical Assumption That Pump and Motor are 100 Percent Efficient

H = head in feet. G = gallons per kilowatt-hour

H	G	H	G	H	G	H	G	H	G	H	G	H	G	H	G	H	G	H	G
1	318,200	51	6,240	101	3,151	151	2,108	201	1,583	251	1,268	301	1,058	351	907	401	794	451	706
2	159,100	52	6,120	102	3,120	152	2,094	202	1,575	252	1,263	302	1,054	352	904	402	792	452	704
3	106,100	53	6,005	103	3,090	153	2,080	203	1,567	253	1,258	303	1,051	353	902	403	790	453	703
4	79,560	54	5,894	104	3,060	154	2,007	204	1,560	254	1,253	304	1,047	354	899	404	788	454	701
5	63,650	55	5,786	105	3,031	155	2,053	205	1,552	255	1,248	305	1,044	355	897	405	786	455	700
6	53,040	56	5,683	106	3,002	156	2,040	206	1,545	256	1,243	306	1,040	356	894	406	784	456	698
7	45,460	57	5,583	107	2,974	157	2,027	207	1,537	257	1,239	307	1,037	357	892	407	782	457	697
8	39,780	58	5,487	108	2,947	158	2,014	208	1,530	258	1,234	308	1,033	358	889	408	780	458	695
9	35,360	59	5,934	109	2,920	159	2,002	209	1,523	259	1,229	309	1,030	359	887	409	778	459	694
10	31,830	60	5,304	110	2,893	160	1,989	210	1,516	260	1,224	310	1,027	360	884	410	776	460	692
11	28,930	61	5,217	111	2,867	161	1,977	211	1,508	261	1,220	311	1,024	361	882	411	775	461	691
12	26,520	62	5,133	112	2,842	162	1,965	212	1,501	262	1,215	312	1,020	362	879	412	773	462	689
13	24,480	63	5,051	113	2,816	163	1,952	213	1,494	263	1,211	313	1,017	363	877	413	771	463	687
14	22,730	64	4,972	114	2,974	164	1,940	214	1,487	264	1,206	314	1,014	364	875	414	769	464	686
15	21,220	65	4,896	115	2,766	165	1,929	215	1,480	265	1,202	315	1,011	365	873	415	767	465	685
16	19,890	66	4,822	116	2,744	166	1,917	216	1,474	266	1,197	316	1,007	366	870	416	765	466	683
17	18,720	67	4,750	117	2,720	167	1,906	217	1,467	267	1,193	317	1,004	367	868	417	763	467	682
18	17,680	68	4,680	118	2,697	168	1,894	218	1,460	268	1,188	318	1,001	368	865	418	761	468	680
19	16,750	69	4,611	119	2,674	169	1,883	219	1,453	269	1,184	319	998	369	863	419	760	469	679
20	15,910	70	4,547	120	2,652	170	1,872	220	1,447	270	1,179	320	995	370	860	420	758	470	677
21	15,150	71	4,482	121	2,630	171	1,861	222	1,434	275	1,171	321	992	371	858	421	756	471	676
22	14,470	72	4,420	122	2,609	172	1,851	222	1,434	272	1,170	322	989	372	856	422	754	472	675
23	13,260	74	4,301	126	2,588	173	1,840	223	1,427	273	1,168	323	996	373	854	423	753	473	674
24	13,260	74	4,301	124	2,567	174	1,829	224	1,421	274	1,162	324	982	374	851	424	751	474	672
25	12,730	75	4,243	125	2,546	175	1,819	225	1,414	275	1,158	325	979	375	849	425	749	475	671
26	12,240	76	4,188	126	2,526	176	1,809	226	1,408	276	1,154	326	976	376	847	426	747	476	669
27	11,790	77	4,133	127	2,506	177	1,798	227	1,402	277	1,150	327	973	377	845	427	746	477	668
28	11,370	78	4,080	128	2,486	178	1,788	228	1,396	278	1,146	328	970	378	842	428	744	478	666
29	10,970	79	4,028	129	2,467	179	1,788	229	1,390	279	1,142	329	968	379	840	429	742	479	665
30	10,610	80	3,978	130	2,448	180	1,768	230	1,384	280	1,137	330	965	380	838	430	740	480	663
31	10,270	81	3,929	131	2,429	181	1,758	231	1,378	281	1,133	331	962	381	836	431	739	481	662
32	9,945	82	3,882	132	2,411	182	1,749	232	1,372	282	1,129	332	959	382	833	432	737	482	660
33	9,644	83	3,834	133	2,393	183	1,739	233	1,366	283	1,125	333	956	383	831	433	736	483	659
34	9,360	84	3,789	134	2,375	184	1,729	234	1,360	284	1,121	334	953	384	829	434	734	484	658
35	9,093	85	3,744	135	2,858	185	1,720	235	1,354	285	1,117	335	950	385	827	435	732	485	657
36	8,840	86	3,701	136	2,340	186	1,711	236	1,349	286	1,113	336	947	386	825	436	730	486	655
37	8,601	87	3,658	137	2,323	187	1,702	237	1,343	287	1,109	337	945	387	823	437	729	487	654
38	8,375	88	3,617	132	2,306	188	1,693	238	1,337	288	1,105	338	942	388	820	438	727	488	652
39	8,160	89	3,576	139	2,292	189	1,684	239	1,332	289	1,102	339	939	389	818	439	725	489	651
40	7,956	90	3,536	140	2,274	190	1,675	240	1,326	290	1,098	340	936	390	816	440	723	490	650
41	7,762	91	3,497	141	2,257	191	1,666	241	1,320	291	1,094	341	934	391	814	441	722	491	649
42	7,577	92	3,458	142	2,241	192	1,658	242	1,315	292	1,090	342	931	392	812	442	720	492	647
43	7,401	93	3,422	143	2,225	193	1,649	243	1,310	293	1,087	343	929	393	810	443	719	493	646
44	7,233	94	3,386	144	2,210	194	1,640	244	1,304	294	1,083	344	926	394	807	444	717	494	644
45	7,072	95	3,350	145	2,195	195	1,632	245	1,299	295	1,079	345	923	395	805	445	716	495	643
46	6,916	96	3,315	146	2,180	196	1,624	246	1,294	296	1,075	346	920	396	804	446	714	496	642
47	6,771	97	3,281	147	2,165	197	1,615	247	1,288	297	1,072	347	918	397	802	447	712	497	641
48	6,630	98	3,248	148	2,150	198	1,608	248	1,284	298	1,068	348	915	398	800	448	710	498	639
49	6,495	99	3,215	149	2,136	199	1,600	249	1,278	299	1,065	349	913	399	798	449	709	499	638
50	6,365	100	3,183	150	2,122	200	1,592	250	1,273	300	1,061	350	910	400	796	450	707	500	636

ficiency up to about 75 percent.

It can be readily seen from the foregoing that the chances of buying a suitable pump from the junk man are just about nil. It might be "as good as new" for the conditions for which it was designed and yet be absolutely worthless under any other conditions. In fact, it would probably be a most expensive liability. Yet pumps have been bought from junk dealers.

So far, the discussion has concerned equipment working under conditions which made it impossible to give a creditable showing. A mere inspection of the conditions and a knowledge of the design limitations would make it evident that satisfactory performance could not be secured under these conditions.

However, there are occasions where, after installation, things happen to properly selected pumps which will cut the efficiency of the equipment. There was, for instance, the time when a water snake was found wrapped around the shaft, with the result that the inlet ports were partially cut off and the suction lift increased way beyond the 15-ft maximum for best performance.

In another and similar situation blocks of wood were found jammed in the ports. Then there was the time that low efficiency was caused by the blowing of the gasket of a multiple-stage pump and the water was short-circuiting back from a higher stage to a lower stage. One engineer once reported that an efficiency of 20 percent was caused by the impeller slipping on the shaft.

Two interesting conditions have been found by the author which have no reference to the actual efficiency of the pumps, but which were determined as the result of making efficiency tests. In one instance, where the meter through which power was purchased was used to measure the power input, it was found that an apparently low efficiency was caused by this meter being set 20 percent high. In another instance, a pump was discharging into a closed distribution system. On the basis of the water actually discharged into the system over a 24-hr period the pump had an efficiency of only 8 percent. Had a standpipe or reservior been floating on this system, the same amount of water could have been pumped with about one-eighth the amount of power which was actually used.

How Tests Are Made

Enough has been said to emphasize the importance of keeping a check on all centrifugal pumping equipment to be sure that it is working in a satisfactory manner. The writer has worked out a simple method for making these tests which he has been using for some years with satisfactory results. At 1-ft head and 100 percent efficiency of both pump and motor it is theoretically possible to raise 318,200 U. S. gallons of water 1-ft with 1 kwh.

To determine this theoretical value for any other head, simply divide 318,200 by the head involved. In this connection Table 1 may prove helpful in reducing calculations in pump testing. For instance, the value at 159 ft would be $\frac{318,200}{159} = 2,002$ gal. per kwh. To determine the wire-to-water efficiency of an installation it is only necessary to divide the actual pumpage per kwh by the theoretical value for the pumping head, as previously determined. A rough check can be made by dividing the month's pumpage in gallons by the kwh consumed. This gives the gallons actually pumped per kwh.

With the pump running, determine the total head in feet (including suction) against which the pump works. Divide 318,200 gallons by this total head (as shown) to determine the theoretical 100 percent pumpage per kwh. Next, divide the actual gallons per kwh by the theoretical gallons per kwh to secure the wire-to-water efficiency.

Example

Assume a monthly pumpage of 32.64 mg and a monthly power consumption of 30,200 kwh. Say the total head noted was 220 ft. Dividing 32,640,000 by 30,200 gives an actual pumpage of 1,081 gal. per kwh. Dividing 318,200 by 220 gives a theoretical value of a possible 1,447 gal. per kwh at 100 percent efficiency.

$$\frac{1,081 \text{ (observer)}}{1,477 \text{ (theoretical)}} = 74.7\%$$

overall wire-to-water efficiency.

Second Method

A more accurate method of making the tests is to measure the power input for an hour, or some other convenient period of time. During this

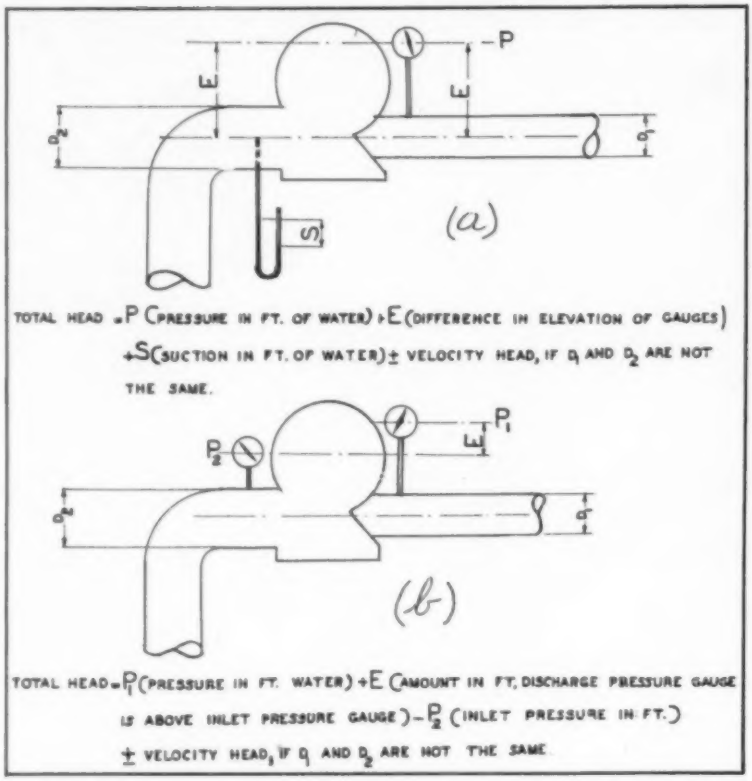

-P
E
E
D_2
D_1
S
(a)
TOTAL HEAD = P (PRESSURE IN FT. OF WATER) + E (DIFFERENCE IN ELEVATION OF GAUGES) + S (SUCTION IN FT. OF WATER) ± VELOCITY HEAD, IF D_1 AND D_2 ARE NOT THE SAME.
P_1
P_2
E
D_2
D_1
(b)
TOTAL HEAD = P_1 (PRESSURE IN FT. WATER) + E (AMOUNT IN FT. DISCHARGE PRESSURE GAUGE IS ABOVE INLET PRESSURE GAUGE) − P_2 (INLET PRESSURE IN FT.) ± VELOCITY HEAD, IF D_1 AND D_2 ARE NOT THE SAME

Fig. 2—HEAD measurement with inlet pipe (a) under suction and (b) under pressure.

period measure the output of the pump with any suitable mainline meter. Keep a close record also of the discharge pressure and the suction. The integrations on most electric meters in pumping stations cannot be read closely enough for short tests. However, the power company will furnish the number of watts consumed for each revolution of the disk, and by counting its revolutions for 10 or 20 minutes the rate of power input can be closely ascertained. Or the power company may be asked to measure the power by means of special equipment. Where more than one pump is taking power through the master meter at the same time, this latter method is the only feasible one for testing each unit separately.

The total head in feet must first be secured. If the pressure gage reads in pounds, convert to feet by multiplying the pounds of pressure by 2.31, the feet of head giving 1 lb of gage pressure. The suction will probably be expressed in inches of mercury. Convert this to feet of water head by multiplying by 1.13. Also measure the vertical distance between the center of the pressure gage and the point of suction measurement. The total head then becomes the sum of the discharge pressure, the suction, the vertical distance, the pressure gage is above the point of suction measurement, and the velocity head, all expressed in feet.

Velocity head generally may be ignored, as it is usually a small factor for the relatively high heads which normally exist in water works operation. However, if the diameter of the suction pipe at the point where the suction is measured varies from the diameter of the pipe at the point where the discharge pressure is measured, the velocity head at each point can be computed from the formula

$$H_{vel} = \frac{V^2}{2g}$$

The suction measurement includes the velocity head at the point of suction measurement, so that all that enters into the computation is the difference in diameter (if any) between the suction and discharge pipes at their respective points of measurement. Thus the velocity head usd in the computation is

$$H_{vel} = \frac{V_1^2}{64.32} - \frac{V_2^2}{64.32}$$

in which V_1 is the discharge velocity and V_2 is the suction velocity. If this quantity should be an appreciable amount it should be included in the total head. However, this is usually true only in the case of very low-head pumps.

A pressure reading is effective at the coil or center of the usual circular gage, whereas suction measurement is effective at the point where the connection is made to the suction pipe. This is because the pipe leading to the pressure gage is filled with water and the pipe leading to the suction gage is filled with weightless air. Of course, if the inlet pipe to the pump is under pressure its takeoff pipe is filled with water and the measurement is made to the center of the gage (see Fig. 2).

A word of caution may not be out of place at this point. The practical limit for suction under summer operating conditions is usually 15 ft. This includes not only the difference in elevation between the pump and the clear well, but also the loss at entrance, the friction loss, and the velocity head in the suction pipe. Therefore, care must be exercised not to set the pumps too far above the clear well or difficulties in operation, attended by low efficiencies, will result.

Computations

We can now proceed to the actual computations.

From the data secured during the test, determine the gallons delivered per kilowatt hour. As before, divide this by the theoretical value for the head against which the pump worked. This gives the over-all wire-to-water efficiency of the installation.

As an example, assume an installation where the following test data were secured on a pump with 8 in. suction and 6 in. discharge:

Power input to motor	90.0 kw		
Rate of discharge	51,840 gph		
Delivery per kwh	572 gal		
Pressure	146 lb	=	337 ft
Suction	15 in	=	17 ft
Diff. in gage elev.	1 ft	=	1 ft
Velocity head	1 ft	=	1 ft
Total head			356 ft

The velocity head was determined in the following manner: The suction having been measured at the 8 in. suction flange and the pressure having been measured at the 6 in. discharge flange of the pump,

51,840 gph
= 864 gpm
= 9.75 fps velocity at 6 in. flange
= 5.50 fps velocity at 8 in. flange

Vel. head at discharge flange

$$= \frac{V_1^2}{64.32} = \frac{(9.75)^2}{64.32} = 1.44 \text{ ft.}$$

Vel. head at inlet flange

$$= \frac{V_s^2}{64.32} = \frac{(5.50)^2}{64.32} = 0.47 \text{ ft}$$

Difference ..... = 0.97 ft

Theoretical discharge at 356-ft Head (from table) ..= 894 gal. per kwh.

Over-all efficiency ...= $\frac{572}{894}$ = 64%

It will be noted that if velocity head had been ignored, the result would have been effected less than 0.3 per cent. If the suction and discharge head measurements had been taken on the 20 in. suction and 16 in. discharge mains, the velocity head would have been almost nothing.

If a suction gage is not available, an approximation may be secured by measuring the vertical distance from the level of water in the clear well to the center of the pressure gage, adding to this measured distance about 3 ft for loss in bends, velocity head, etc.

Having shown the desirability of frequent tests and a simple method for making them, it may now be interesting to discuss what these tests may be expected to show. In the first place, there have been great increases in the attainable efficiencies of centrifugal pumps within the past few years. Those of modern design may be expected to give up to the following over-all (wire-to-water) efficiencies. It will be noted that the larger the pump, the higher the efficiencies (see Table 2).

TABLE 2
Centrifugal Pump Efficiencies

Capacity gpm	Efficiency %
200	62
400	65
600	68
800	71
1,000	73
1,500	75
3,000	80
5,000	82
5,000+	85

There will be variations from the values of Table 2, depending on the head and other conditions. They are submitted only for the purpose of giving something with which to compare the efficiencies of existing installations. This is important, because it will often be found that older equipment may have retained its original efficiency and yet be so inefficient in comparison with modern equipment now available that it is decidedly uneconomical to keep it in operation.

It will be worthwhile to check the present efficiency of equipment now more than ten years old, to determine how great a reduction in power consumption can be secured by the substitution of more efficient modern pumps. If an old 1,000-gpm pump, operating at an efficiency of 57 percent, is replaced with a new pump giving an over-all efficiency of 73 percent the same amount of water may be pumped with 22 percent less power.

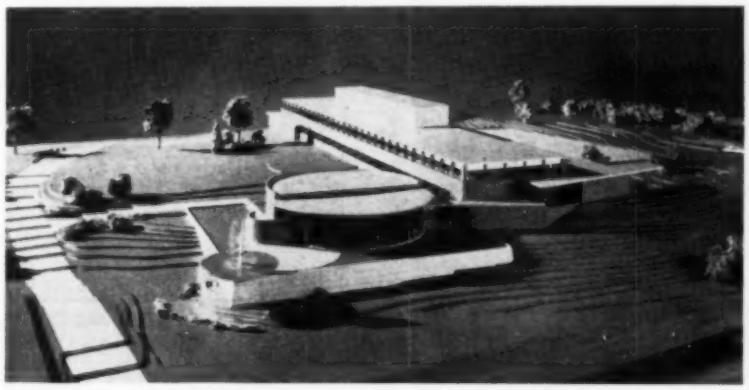
This means that both the demand rate and the power consumption through each step of the existing rate schedule would be decreased 22 percent. Such a reduction might be enough to pay for the new installation in about one year's time. In order to get the gallons per kwh to be expected at any head, for any efficiency, it is only necessary to determine the theoretical gallons per kwh for that head and then multiply this theoretical value by the expected efficiency. If the total pumpage in gallons is then divided by this expected pumpage per kwh, the power consumption to be anticipated from the new installation will be secured. Similarly it is possible to determine the anticipated demand rate, which is often as important (if not more so) than is the total kwh consumption in determining the power bill.

Ontario Modern Research Center and Laboratory

Contracts have been awarded in Ontario, Canada for the construction of a new laboratory facility for the Ontario Water Resources Commission. This building, long the dream of Dr. A. E. Berry, Gen. Mgr. and Ch. Engr. of the Commission and A. V. Delaporte, Director of Research and Laboratory, will be one of the most modern laboratories of its kind.

The new laboratory facilities will be located overlooking the Humber River in Etobicoke Township in the Municipality of Metropolitan Toronto. It will incorporate ideas from the most efficient laboratories on the continent. It will consist of a 320-ft. long split-level building on auxiliary structures and ample room will be provided for future expansion. The entire structure totals some 53,000 sq. ft. On the second floor of the main building there will be fourteen major laboratories, together with auxiliary accommodations for scale rooms, refrigerated rooms and laboratory office equipment, etc. Provision is made for controlled temperature and humidity. On the ground floor provision is made for a major open experimental area, plus facilities for storage, for bottle washing and for general mechanical servicing of the building. An auditorium to seat 160 and a cafeteria to seat 100 employees will be part of the center. A system of sun control has been devised for the laboratory section. Since interior sun screens by blinds and drapes are undesirable in laboratories, a system has been devised by which vertical fins at 11 ft centers will prevent direct contact by the sun on windows in early morning and late afternoon; wide horizontal louvres above the windows will prevent direct contact during the day. A nearby sanitary sewer will provide sewage for experimental operations in the main building.

Regarding the new building, Dr. Berry has said, "The new laboratory will enable the commission to carry out a much expanded activity in the water supply and pollution program. The laboratory, which will be most modern in its functioning, will fill a long-felt want." Mr. Delaporte and his staff have been carrying out their work under adverse conditions in the present out-moded lab on Richmond Street in Toronto.



W & SW

TECHNICAL DIGEST

Surges in Pipe Lines

by DONALD R. F. HARLEMAN, Sc. D.

ACCORDING to Dr. Harleman, water hammer pressure waves travel in closed systems at 4000 ft per sec but surge waves, in conduits employing surge chambers, travel very slowly. To present this subject of surge waves, Dr. Harleman sketched the system shown in Fig. 1 and asked the question: "What happens in this system (BC) when the valve at A is closed?"

Prior to closing the valve, water is flowing from Reservoir C through the pipe line, and the water level in the surge chamber stands level (h_2), which is below the level (h_1) in the reservoir. The difference in elevation between the two ($h_1 - h_2$) is equal to the friction loss in the pipe line and the line hg indicates the hydraulic grade line between B and C.

If valve A is closed (termed "flow-off" condition) at time t_o, the water continues to flow into tank B until the level reaches a maximum height, h_3 in time t_1, then the flow reverses in the line and the water level in the tank drops to h_4 in time t_2, at which time the flow starts back into the surge tank; this time the water level rises in B to a height less than h_3 and the flow again reverses. This surging back and forth continues with the height reached each time in B, less than the previous time, until a final state is reached when the level in the tank becomes the same as the level in the reservoir and flow stops in the conduit.

This type of system gives a lower surge pressure than water hammer and is cheaper to build than to prepare for water hammer. The change in tank level is shown in Fig. 2. Curve A shows what the level would be if there were practically no friction in the pipe line (the friction effect is only about 10 per cent). Curve B shows how the level actually changes as the surges are damped out.

Height of Surge Tank

The first surge shows no effect of friction and the maximum height reached by the water level (equal to $h_3 - h_1$ and termed Y_o) determines the height of the surge tank. The equation for this determination is:

$$Y_o = V_o \sqrt{\frac{L_c A_c}{g A_t}} \qquad \text{Eq. 1}$$

(See Fig. 1)

but since the areas A_c and A_t involve the square of the respective diameters, the equation may be written

$$Y_o = V_o \frac{D_c}{D_t} \sqrt{\frac{L}{g}} \qquad \text{Eq. 2}$$

As an example, Dr. Harleman used these data: $V_c = 10$ fps, $D_c = 1$ ft, $D_t = 5$ ft, $L_c = 3220$, and $g = 32.2$. Substituting these values in Eq. 2, $Y_o = 20$ ft.

Dr. Harleman is Assoc. Professor at Mass. Inst. Tech., in Cambridge, Mass. His paper was presented before the March Meeting of NEWWA in Boston, Mass.

Oscillation periods between peaks are determined by the equation

$$T_o = 2\pi \sqrt{\frac{L_c A_t}{g A_c}}$$

$$= 2\pi \left(\frac{D_t}{D_c}\right) \sqrt{\frac{L_c}{g}} \qquad \text{Eq. 3}$$

In the example cited $T_o = 300 +$ seconds or $5 +$ minutes. This period remains constant and is not affected by friction. (Note, by comparison the period of water hammer waves if this were a closed system would be about 1 second.) It will be noted in Fig. 2 that it takes four cycles to reduce the

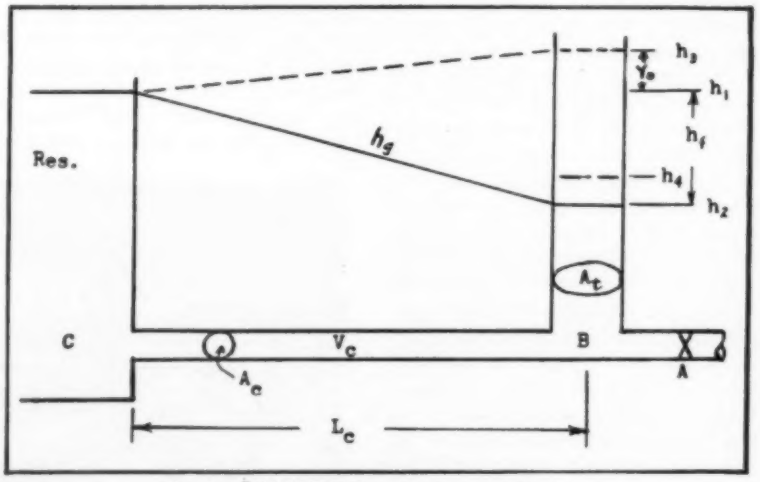


Fig. 1—SURGE TANK on line from reservoir.

A=valve; B=surge tank; C=reservoir; A_c=area of conduit; V_c=velocity in conduit; L_c=length of conduit; A_t=area of surge tank. Other symbols explained in text.

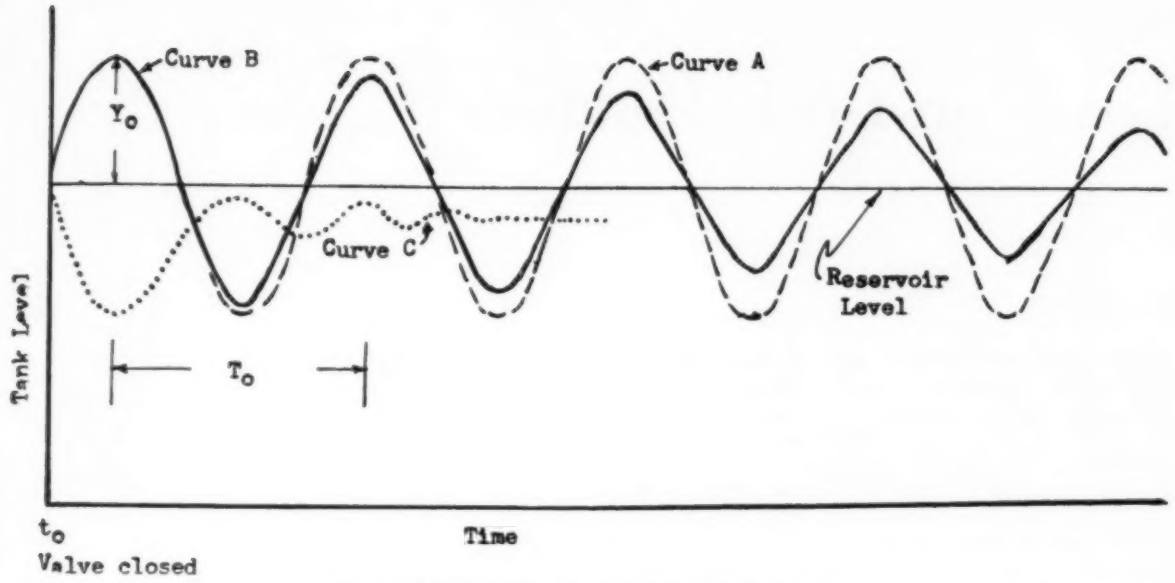


Fig. 2—SURGE CYCLES exhibited in system shown in Fig. 1.

Curve A=theoretical cycling without friction; "flow-off" condition.
Curve B=actual cycle pattern showing effect of friction.
Curve C=actual cycle pattern for "flow-on" condition.

height of the surge by 50 per cent and about ten more cycles to reduce it to 25 per cent.

If the valve A were opened and closed frequently during the cycling periods, it is possible to produce "resonance" and build up surges to greater than h_3.

When the reverse situation occurs, i.e., no flow, tank level at h_1 and the valve A is opened, the condition is termed "flow-on". The level immediately drops and there is a reverse surging as indicated in Curve C in Fig. 2. This type of surge damps out very quickly. Since the tank must be high enough to prevent drawing air under these conditions, it is customary to design the tank height to be 1/2 of this drop at "flow-on" condition, plus the maximum height at "flow-off" condition.

Restricted Orifice and Differential Surge Tanks

The simple surge tank described above is less common than the restricted orifice or differential type of surge tank. These are shown in Fig. 3. In both types the water comes to rest in the tank sooner than in the simple surge tank. In the case of the orifice type, the smaller the orifice, the faster equilibrium conditions are reached, but the higher the pressures put on the conduit.

With the differential type of tank, damping of the surge waves is faster but not so much pressure is created as in the restricted orifice type. With either of these types of tanks, the height of the tank can be less than that of a simple surge tank.

Dr. Harleman gave examples of the use of surge tanks and especially referred to the sudden opening and closing of wicketts on pen stocks for hydro-electric generators.

Farley Gannett Dies

Farley Gannett, chairman of the board of Gannett, Fleming, Corddry and Carpenter, Inc. consulting engineers of Harrisburg, Pa., died in Garfield Memorial Hospital in Washington, D. C. on Jan. 20. Mr. Gannett was in Washington to attend the meeting of the American Road Builders Association. He was 77.

A native of Pennsylvania, he was graduated from MIT in 1902 and for 10 years served as chief engineer of the Water Supply Commission. Later he organized the consulting engineering firm which bore his name. His firm was active in highway and sanitary engineering design. He was a member of ARBA, ASCE, AWWA, Engineering Society of Pennsylvania, Cosmos Club of Washington and other organizations.

Pa. Clean Streams Program Reports Progress

In a recent survey, the Pennsylvania Clean Streams Program showed that in the 12 years that the program has been underway 131 sewage treatment plants have been built or placed under construction. The industrial side of the program shows that at least an equal amount of progress has been made by industry.

Former Sanitary Water Board Chairman Berwyn F. Mattison, now Executive Secretary of the APHA, was satisfied with the progress made by the program but warned that there was still a job to be done.

From the "Denver Water News"

With the water bills in Denver, comes a house organ entitled "Denver Water News." A recent issue carried the following information. "In past years, alternating freezing and thawing in Platte Canyon could mean a serious ice jam at Intake, where water for the Denver system from the South Platte watershed enters the first series of distribution conduits.

Now, before winter sets in, wooden sheet piling and a wooden flume are erected. Ice jams against the piling, which screens the intake, and is flushed harmlessly down the flume."

Alignment Chart for

Loads on Ditch Conduits

THE ACCOMPANYING chart provides a method for finding the necessary type of embedment for clay or concrete pipe in trenches, depending on type and density of soil, depth and width of trench, pipe size and safety factor. The solution to a problem is indicated in the key in Fig. 1. Starting at the lower left corner, a line (1) is drawn through Depth of Backfill and Trench Width (lower scale) to Depth/Width, and extended vertically (2) to a point on the curve corresponding to the type of backfill used. By extending this point horizontally to the right (3), Coefficient C_d is found. A line (4) through Density of Fill and Trench Width (upper scale) locates a point on pivot line A, and a line through this point and the previously determined Coefficient C_d yields Load on Pipe. A line (6) through Safety Factor and Pipe Size locates a point on pivot line B, and a line (7) through this point and Load on Pipe determines the required Embedment. Alternatively, the pivot point (B) is located by a line (7) through Load on Pipe and Embedment, and a line (6) through this point and Pipe Size gives the Safety Factor for the assumed conditions.

That portion of the chart which determines Load on Pipe is based on Marston's ditch loading formula:

$$W_c = C_d w B_d^2,$$

where W_c = load on pipe in lb/lin ft
C_d = a coefficient
w = density of fill in lb/cu ft
B_d = width of trench at top of pipe in ft

by L. E. LIVINGSTON, JR.

Mr. Livingston is a sales engineer in the firm of L. E. Livingston & Son in Dallas, Texas.

In the accompanying charts he has produced a ready tool for designing engineers.

Pipe Sizes

Three Pipe Size scales are shown, with the corresponding ASTM specification number: C76-52 for standard strength reinforced concrete culvert pipe, C200-50T for extra strength clay sewer pipe, and C14-52 for concrete sewer pipe to 24-in. The C14-52 scale is extended to 36-in. based on ASTM C13-50T (standard strength clay sewer pipe). For simplicity, standard strength clay pipe sizes below 24-in. are omitted. These sizes generally will meet the C14-52 specifications, which are only slightly higher. The C76-52 scale is based on the load necessary to produce a 0.01-in. crack, and all scales are based on three-edge bearing strength.

Types of Embedment

The four types of embedment used in the chart are as shown in Fig. 2. Nomenclature and load factors are as given in the Concrete Pipe Handbook (American Concrete Pipe Association, 1951). A Load Factor scale is included to facilitate calculations involving other types of embedment, as for example, pipe encased in concrete, where the load factor may be taken as 2.8 plus encasement.

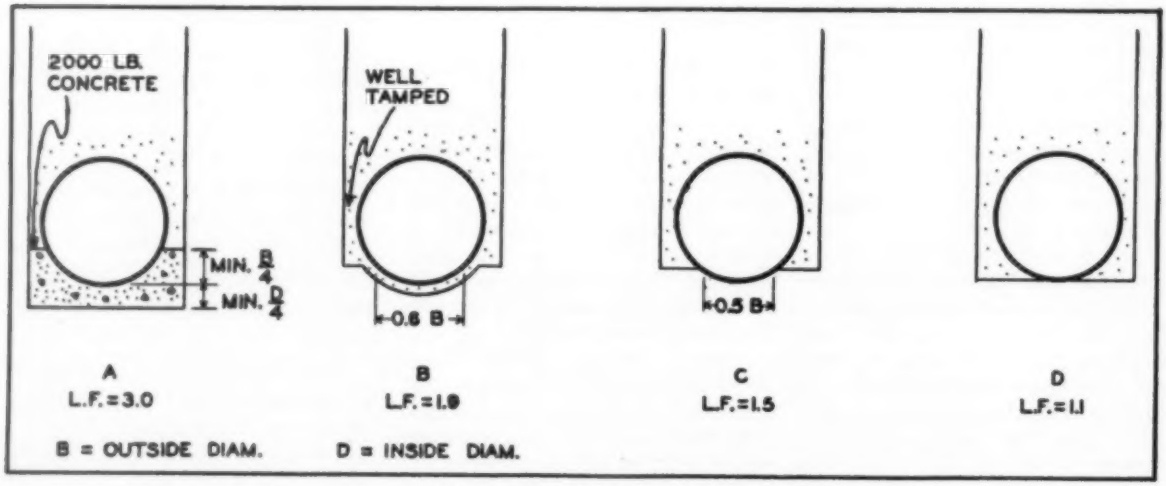


Fig. 2—FOUR types of embedments.

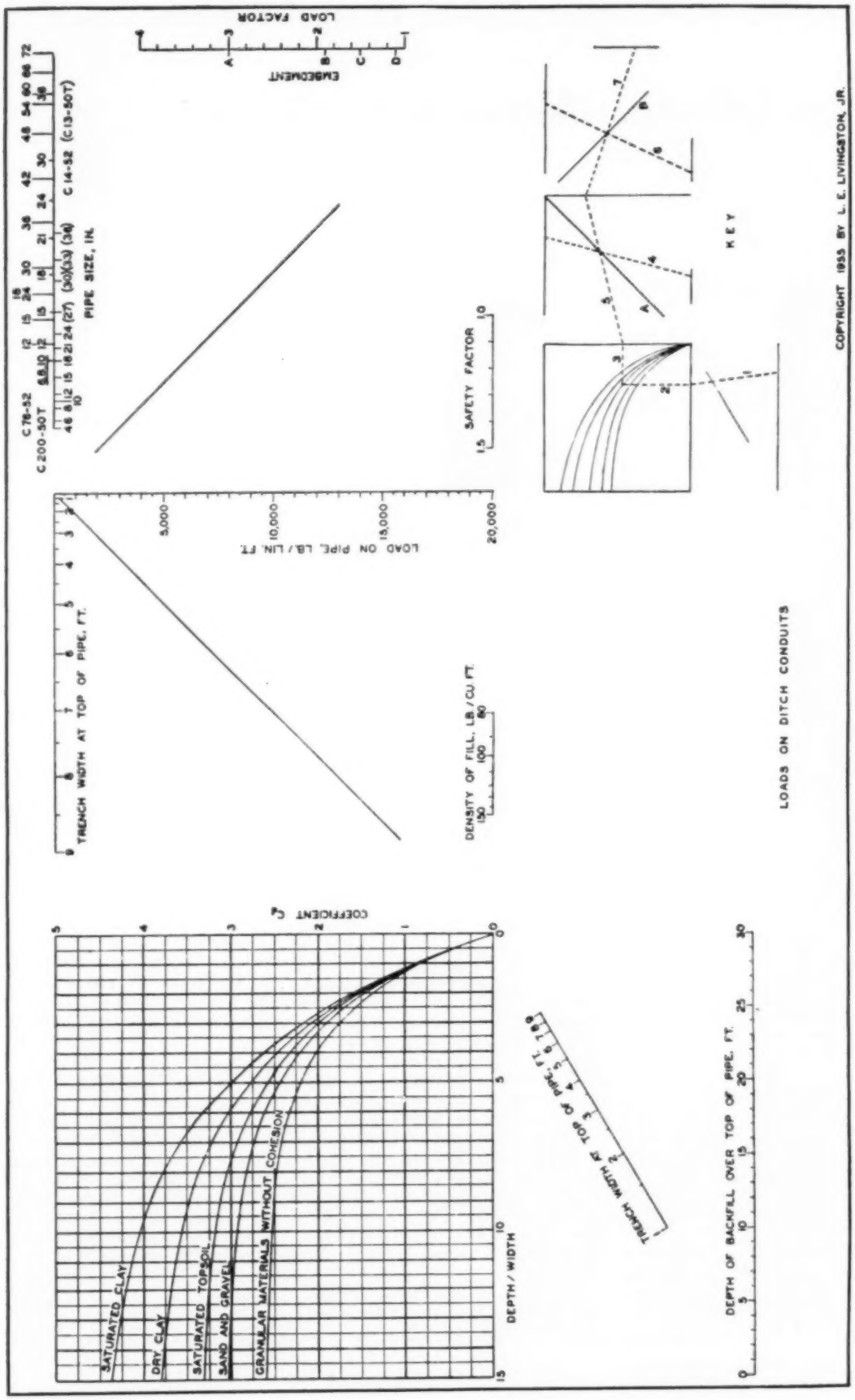


Fig. 1—ALIGNMENT chart for loads on ditch conduits.

A convenient and satisfactory method of disposal for many coastal communities consists of . . .

Sewage Effluent Dilution *In Sea Water*

CHARLES H. LAWRANCE, Sanitary Engineer, Hyperion Engineers, Los Angeles, Calif., reports here the observed results of survey work performed in connection with the Hyperion plant project.

EXTENSIVE recent oceanographic surveys for the City of Los Angeles, California, in connection with plans and designs for current expansion of sewerage facilities, have served to focus attention on the fundamental nature of dilution of sewage effluent in sea water. This method of disposal of sewage wastes has found extensive application in many of the coastal cities of this country and has been studied and comprehensively reported on by Pearson in a recent report to the California State Water Pollution Control Board[1].

California has its share of coastal cities that dispose of sewage effluent to the ocean. Many of these receiving waters, especially in Southern California, are bordered by extensive bathing beaches used virtually throughout the year. Due to the semi-arid nature of the southern part of the state there are no streams discharging sufficient volumes of fresh water on a year-round basis to be of much significance in providing flushing or diluting action for substantial flows of sewage wastes. Rather, these flushing and diluting actions are matters of local oceanography.

In some cases, the submarine outfalls discharge chlorinated secondary effluents at points only a few fathoms deep and at relatively short distances offshore. This type of treatment and disposal has been effective in maintaining acceptable quality of the receiving waters, and has, of course, been used in many parts of the country.

In other cases it has been found generally satisfactory to construct longer and deeper submarine outfalls, several thousand feet long and several fathoms deep, often with diffusers, and to discharge effluent of lower grade, sometimes even unchlorinated primary effluent.

The designer of such an installation should have a general understanding of the phenomena of dilution of sewage effluent with sea water. It is important for him to understand how dilution takes place, and also the manner in which the dilution takes place, and also the manner in which the dilution of dilution effects from bacteripoint may be determined. Knowledge of actual dilutions experienced under various conditions is necessary for proper appraisal of the design of existing outlets or diffusers, for separation of dilution effects from bactericidal and other effects that also reduce bacterial densities, and for studying the interplay of such parameters as rates of dilution and rates of bacterial decline.

These responsibilities were included in the functions of Hyperion Engineers, a joint venture of the Los Angeles consulting engineering firms of Holmes & Narver, Inc.; Daniel, Mann, Johnson, & Mendenhall; and Koebig & Koebig. As described in part by Pardee and Studley[2], these engineering firms performed the engineering design for several major enlargements and additions to the City of Los Angeles sewerage system, including a major trunk sewer, enlargements and modifications to the existing Hyperion sewage treatment plant, sludge and effluent pumping stations, and two major ocean outfalls, one for sludge discharge and the other for effluent disposal. The sludge outfall is nearly 7 miles long, terminating in 300 feet of water. The effluent will be over 5 miles long, terminating in a large diffuser located in nearly 190 feet of water.

As an aid to the design of these two submarine sewer outfalls, considerable oceanographic and special bacteriological offshore survey work was carried out by the Allan Hancock Foundation of the University of Southern California[3]. A large amount of similar work was also accomplished by the City of Los Angeles' Bureau of Sanitation and these findings also were followed closely. As a result of this Hyperion project much has been learned that should be of general interest to the profession.

How Dilution May Be Determined

Sewage concentration in a mixture of sewage effluent and sea water may be measured by several means, including chemical, physical, and even biological. Chemical means include the measurement of free and albuminoid ammonia, chlorinity or salinity, phosphates, and radioactive substances. Physical means include density and the use of dyes. Salinity may be determined from hydrographic tables, using density and temperature determinations. Biological means utilize the numbers of coliform or other types of bacteria present in the mixture.

The constituent common to the effluent is measured in the mixture of effluent and sea water. Then using representative values of this constituent in undiluted effluent and in sea water unaffected by the effluent discharge, the dilutions which have taken place may be computed.

Formulas for Computing Dilutions

The following is adapted from the

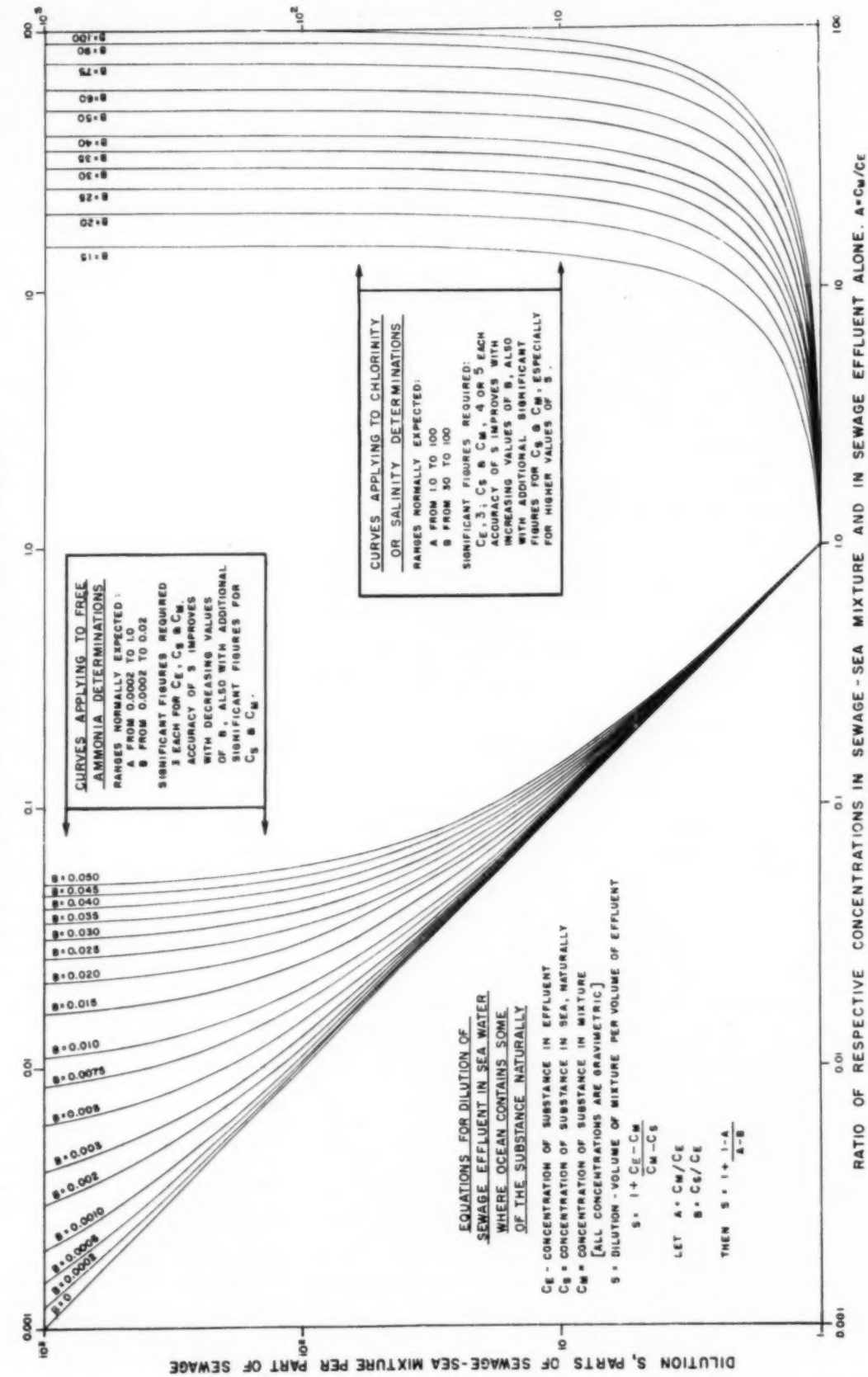

CURVES APPLYING TO FREE AMMONIA DETERMINATIONS
RANGES NORMALLY EXPECTED:
A FROM 0.0002 TO 1.0
B FROM 0.0002 TO 0.02
SIGNIFICANT FIGURES REQUIRED
3 EACH FOR Ce, Cs & Cw.
ACCURACY OF S IMPROVES WITH DECREASING VALUES OF B, ALSO WITH ADDITIONAL SIGNIFICANT FIGURES FOR Cs & Cw.
CURVES APPLYING TO CHLORINITY OR SALINITY DETERMINATIONS
RANGES NORMALLY EXPECTED:
A FROM 1.0 TO 100
B FROM 30 TO 100
SIGNIFICANT FIGURES REQUIRED:
Ce, 3; Cs & Cw, 4 OR 5 EACH
ACCURACY OF S IMPROVES WITH INCREASING VALUES OF B, ALSO WITH ADDITIONAL SIGNIFICANT FIGURES FOR Cs & Cw; ESPECIALLY FOR HIGHER VALUES OF S.
EQUATIONS FOR DILUTION OF SEWAGE EFFLUENT IN SEA WATER WHERE OCEAN CONTAINS SOME OF THE SUBSTANCE NATURALLY
Ce - CONCENTRATION OF SUBSTANCE IN EFFLUENT
Cs = CONCENTRATION OF SUBSTANCE IN SEA, NATURALLY
Cw = CONCENTRATION OF SUBSTANCE IN MIXTURE
[ALL CONCENTRATIONS ARE GRAVIMETRIC]
S = DILUTION - VOLUME OF MIXTURE PER VOLUME OF EFFLUENT
$S = 1 + \frac{Ce - Cw}{Cw - Cs}$
LET A = Cw/Ce
B = Cs/Ce
THEN $S = 1 + \frac{1-A}{A-B}$
B=0.050
B=0.045
B=0.040
B=0.035
B=0.030
B=0.025
B=0.020
B=0.015
B=0.010
B=0.0075
B=0.005
B=0.003
B=0.002
B=0.0010
B=0.0005
B=0.0002
B=0
B=1.00
B=.90
B=.75
B=.60
B=.50
B=.40
B=.35
B=.30
B=.25
B=.20
B=.15
DILUTION S, PARTS OF SEWAGE-SEA MIXTURE PER PART OF SEWAGE
RATIO OF RESPECTIVE CONCENTRATIONS IN SEWAGE-SEA MIXTURE AND IN SEWAGE EFFLUENT ALONE. A=Cw/Ce

Fig. 1—CURVES for determining dilution of sewage in sea water.

CURVES FOR DETERMINING DILUTION OF SEWAGE IN SEA WATER

nomenclature and analysis of Ketchum *et al.*[4]:

F_e = Fraction, volumetric, of sewage effluent in mixture of effluent and sea water;

F_s = Fraction, volumetric, of sea water in mixture of effluent and sea water;

C_e = Concentration, gravimetric, of substance such as ammonia, chlorinity, or density, in sewage effluent alone;

C_m = Concentration, gravimetric, of substance in mixture of sewage effluent and sea water; and

C_s = Concentration, gravimetric, of substance in unpolluted sea water naturally.

A mixture of sewage effluent and sea water contains the following concentration of the tracer substance:

$$C_m = F_e C_e + F_s C_s = F_e C_e + C_s \times (1 - F_e) \quad (1a)$$

Therefore, the fraction of sea water in a mixture of sewage effluent and sea water is

$$F_s = \frac{C_e - C_m}{C_e - C_s} \quad (1b)$$

Similarly the fraction of effluent in the mixture is

$$F_e = \frac{C_m - C_s}{C_e - C_s} \quad (2)$$

The percentage sewage effluent in the mixture is

$$100\, F_e = 100 \left(\frac{C_m - C_s}{C_e - C_s}\right) \quad (3)$$

If there is none of the measured substance (chemical or bacterial) present in the sea water naturally, Eq. 1 reduces to

$$F_s = \frac{C_e - C_m}{C_e} \quad (4)$$

and Eq. 3 reduces to

$$F_e = \frac{C_m}{C_e} (100) \quad (5)$$

An example of the use of this relationship is in the measurement of colored dyes introduced artifically to determine dilutions.

The dilution of sewage effluent may be expressed in terms of volumes of sea water per volume of sewage. However, following the nomenclature of Rawn and Palmer[5], the dilution is more readily expressed as a dilution factor, S, representing the volumes of unpolluted sea water and 1 volume of sewage effluent per volume of sewage.

Thus,

$$S - 1 = F_s/F_e \quad (6a)$$

or

$$S = 1 + F_s/F_e = (F_e + F_s/F_e \quad (6b)$$

$$S = 1/F_e = 100/(\%\ \text{sewage effl.}) \quad (6c)$$

Also

$$S = 1 + F_s/F_e = 1 + F_s/(1 - F_s) \quad (7)$$

$$S = 1 + \frac{\frac{C_e - C_m}{C_e - C_s}}{\frac{1 - C_e - C_m}{C_e - C_s}} \quad (8a)$$

from which

$$S = 1 + \frac{C_e - C_m}{C_m - C_s} \quad (8b)$$

This is the general equation where the tracer constituent is found in effluent, unpolluted sea water, and mixture alike.

Where the sea water contains none of the measured constituent naturally, Eq. 8*b* reduces to

$$S = 1 + \frac{C_e - C_m}{C_m} = \frac{C_e}{C_m} \quad (9)$$

This is, in effect, the reciprocal of Eq. 5.

To facilitate the determination of sewage effluent dilution with sea water from field measurements of constituents found naturally to some extent in both the effluent and the diluting waters, Fig. 1 has been prepared. A second purpose of Fig. 1 is to help illustrate the attendant problem of accuracy in the establishing of dilutions under field conditions.

Accuracy of Dilution Measurements

Sewage effluents are generally heterogeneous; primary effluents more so than secondary effluents. The constituents not only may vary to some extent within a given slug at a given time, but they also may vary in strength over a period of time. Therefore, in order to have confidence in a representative value for the tracer constituents' concentration, it is desirable to have analyzed a fairly large number of effluent samples covering a large span of time. In many cases it is also desirable to sample the effluent before and during the course of offshore dilution studies.

Where receiving waters naturally contain some of the tracer constituent that is also found in the effluent, there is always the question as to what concentration should be considered representative for the waters that will be used to dilute the sewage effluent. Often these values will vary not only in horizontal distance away from the point of effluent discharge, but also vertically in the receiving waters. It is known that the sewage effluent receives dilution from different levels as it rises upon injection, and from different areas as it moves away from the point of injection subsequently.

Furthermore, the receiving waters themselves are not static but vary with time. Fresh water runoff, water mass movements, and signiflcant evaporation are among the factors that sometimes become important. Despite all these difficulties, if enough samples are taken at surface and depth over a wide enough area to permit proper exercise of judgment, a representative value of concentration of the constituent can usually be assigned for the diluting water during a given study.

The relative magnitude of the values of C_e, C_m, and C_s will also be important in determining the accuracy of the computed dilutions. The actual proportion of the tracer constituent in the natural sea water with relation to that of the effluent may be as important as the proportion of the constituent in the sampled mixture to that of the effluent. This is illustrated by the nature of Eq. 8*b*, the general dilution equation, for any given respective values of C_e and C_s, it will be seen that as a the value of C_m diminishes the value of S begins to increase rapidly. Consider also Eq. 1*b* and 7 together. Note that, for instance,

if $C_e - C_m$ is 4% less than $C_e - C_s$, then $S = 25$;

if $C_e - C_m$ is 3% less than $C_e - C_s$, then $S = 33.3$;

if $C_e - C_m$ is 2% less than $C_e - C_s$, then $S = 50$; and

if $C_e - C_m$ is 1% less than $C_e - C_s$, then $S = 100$.

Some of the tracer constituents which it may be desired to employ for measurement of dilution are likely to be unstable. This is, of course, true of bacteria where, except possibly for measurement of initial dilution, the reduction in densities due to bactericide, sedimentation, predation by zooplankton, and other factors will give apparent dilutions appreciably greater than true physical dilution.

This instability is also true of radioactive substances, which are subject to decay. However, because the various rates of decay are generally known in advance, proper account may be made in the computation of dilutions. Radioactive substances may be specially introduced into the effluent under controlled conditions for tracer purposes[6]. On the other hand, they may be present naturally both in the effluent and in the receiving waters in differing and fluctuating concentrations[7 8].

Examination of the curves in Figure 1 in the area applicable for free ammonia indicates that this consti-

tuent should be an ideal tracer from the standpoint of accuracy because of the relative flatness of the curves. Unfortunately, this advantage is offset by a certain inherent instability of free ammonia. Like bacteria, both free and albuminoid ammonias are subject to biochemical and biological influences in their concentrations, hence they indicate dilutions which are not necessarily true, at least in terms of pure diluting water fresh from the ocean. They will ultimately decline under natural conditions.

This fact must be borne in mind in the use of such unstable indices. Also, great care must be used in establishing the true nature of the diluting water, whether unpolluted or previously polluted to some degree, and not fully recovered. In receiving waters for sewage effluent, there often will be a certain background level of ammonia originating from the discharge but representing diluting water fairly well recovered from previous pollution.

Significant numbers exert considerable influence on accuracy. If, for example, C_e and C_m were each accurate to three significant figures but C_e has but one decimal place as opposed to three decimal places for C_m, the significance of the second and third decimal places for C_m is lost. Therefore, the ranges of accuracy of dilution determinations are limited by the accuracy of the various laboratory methods employed in measuring dilution.

Limits of Accuracy of Dilution Determinations

Rawn and Palmer[5] found that silver nitrate titrations for chlorinity measurement could be used to determine dilutions up to 35 or 40 with accuracy, that a conductivity method for determining the thickness of a sewage field could detect a dilution of 25, and that they could measure dye-colored fresh water-sea water dilutions with fair accuracy to dilution value of 150.

Investigators of the Metropolitan Sewerage Commission of New York found that certain dyes permit detection of dilutions in the millions[5].

In the radioactive tracer experiment in Santa Monica Bay, personnel of Nuclear Science and Engineering Corporation found that the dilution was capable of being followed to a value of 10,000 to 1[6]. This experiment involved a radioactive compound placed in the effluent by artificial means.

On the other hand, where natural radioactivity is involved the accuracy of dilution measurement is reduced. Bullen and O'Connor[7] have described a method for measuring radioactivity of radon gas on sewage and in sewage effluent mixed with sea water. They have also discussed its potentialities as a tracer and means of measuring dilutions[8].

Conway[9] found that dilutions of sewage in sea water may be measured up to values of 100 by salinity methods, to 300 by ammonia, and to 1 million by bacteria.

Pearson [1] has discussed the nature and accuracy of the various methods for determination of salinity, chlorinity, temperature, and density.

Example of Dilution Computed from Chlorinity

The chlorinity of sea water is approximately the concentration of chlorides in it, but more specifically is the number of grams of halogens precipitated by standard silver nitrate solution for each kilogram of sea water. This assumes that whatever small amounts of iodine and bromine may be present are replaced by chlorine as chlorides. The chlorinity concentration is usually expressed in parts per thousands, with normal sea water having a chlorinity in the order of 19.4 parts per thousand.

The salinity of the sea water is the concentration of the total dissolved solids and is usually taken as equal to 1.805 times the chlorinity, plus 0.03, the results also being in parts per thousand. It is assumed that all the halogens are represented as chlorides (practically true), that all carbon dioxide is unbound, and that there is no unoxidized organic matter. Surface sea water normally ranges between about 33 and 37 parts per thousand[10].

If determined by standard methods involving titration of the sample with silver nitrate solution[10 11], the chlorinity of a sample of the effluent can readily be determined to three significant figures. This is an adequate number of significant figures for the effluent. Due to the likelihood of some variations in the chlorinity of the effluent, probably not more than three significant figures should be taken as representative of a series of effluent samples over an extensive period of time or during the time of a dilution study. For this example, assume $C_e = 245$ ppm $= 0.245$ parts per thousand chlorinity.

In the case of the offshore waters, assume that direct titration of the samples of unpolluted sea water reads 19.4 parts per thousand and of the mixture in question reads 19.2 parts per thousand. The observing significant figures, from Eq. 8*b*

$$S = 1 + \frac{0.2 - 19.2}{19.2 - 19.4} = 1 + \frac{19.0}{0.2}$$
$$= 1 + 95 = 96$$

Next assume that laboratory techniques such as use of microburettes and/or back-titration were employed in such a manner as to warrant a fourth significant figure for the offshore samples. Assume $C_s = 19.40$ parts per thousand and $C_m = 19.24$ parts per thousand. Then

$$S = 1 + \frac{0.25 - 19.24}{19.24 - 19.40} = 1 + \frac{18.99}{0.16}$$
$$= 1 + 119 = 120$$

Now assume that gravimetric laboratory methods are employed for determining the chlorinities of the offshore samples in such a manner as to warrant adoption of a fifth significant figure for these results. Assume $C_s = 19.400$ parts per thousand and $C_m = 19.249$ parts per thousand. Then

$$S = 1 + \frac{0.245 - 19.249}{19.249 - 19.400} =$$
$$1 + \frac{19.004}{0.151} = 1 + 126 = 127$$

Thus, at this extreme the least accurate determination would indicate nearly 25 percent less than those of the most accurate determination. At the opposite extreme, with the same values in the least accurate determination, the indicated results would be about 25 percent greater than those of the most accurate determination.

This example illustrates the great discrepancies that are possible between dilution values computed from measurements of differing degrees of accuracy taken from the same sample. The values used in the example were typical for certain effluents and receiving waters. This example, together with a consideration of Figure 1, seems to indicate some support to Conway's opinion of the limitations of salinity for determining dilutions, at least where no more than normal laboratory precision is used. It should also be remembered that salinity is not quite directly proportional to chlorinity and this may affect the results of computations somewhat.

How Sewage Effluent Becomes Diluted with Sea Water

Ordinarily the dilution of effluent with sea water may be separated into two phases: (a) initial dilution of effluent as it rises from its point of subaqueous injection to the surface of the ocean, and (b) subsequent dilution of the initial mixture or "sewage field" as it moves away from the point of origin. The mathematical treatment of these dilution phenomena is rather complex and is outside the scope of

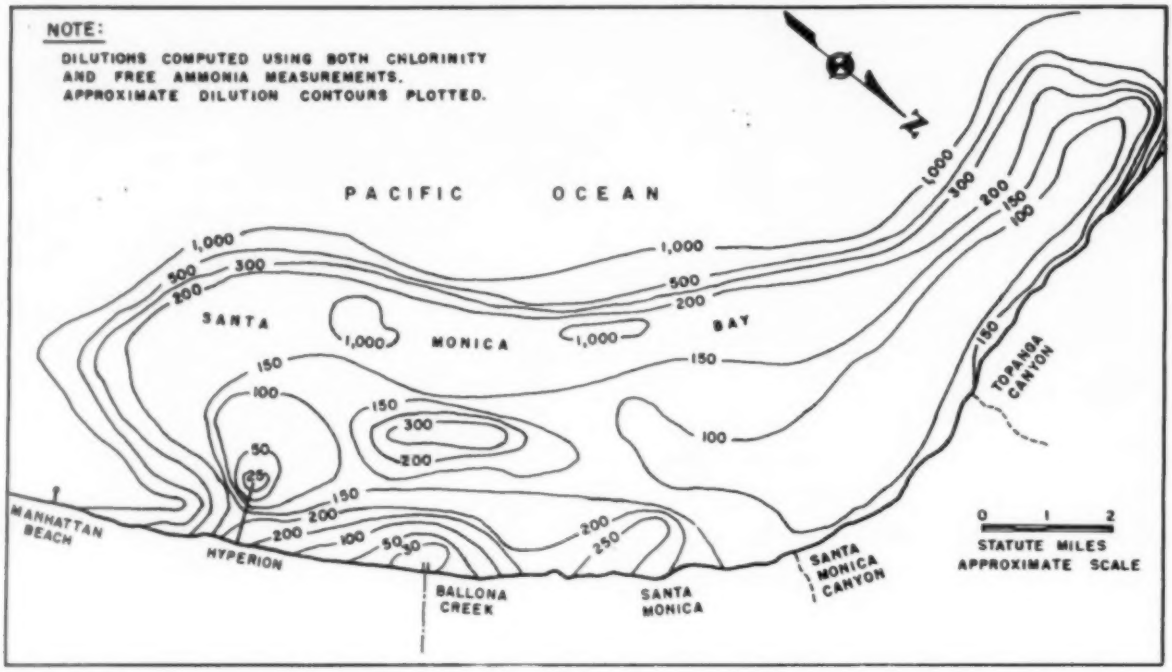


Fig. 2—DILUTION survey in Santa Monica Bay, Dec. 28, 1955, in area influenced by discharge from Hyperion outfall.

this paper, beyond a few generalities. Nevertheless, some general information can readily be presented.

In approaching the subject, it is often helpful to recall appropriate analogies of mixing phenomena. For example, oils and fats normally "float on water" because they are less dense than water. Smoke rises into the atmosphere for the same reason. It is obvious that sewage effluent is relatively "fresh" water and therefore will tend to rise under the influence of the heavier salt water into which it is discharged.

The rising jet will have a turbulent boundary layer with the surrounding ocean, and this turbulence will tend to accelerate dilution of the jet, the outside first and the inner core last. If the jet becomes diluted progressively in its rising trajectory the density differential causing the upward acceleration will be progressively reduced. The turbulence of the two liquids and their boundary layer tends also to limit the upward acceleration. Therefore the jet rises at somewhat constant velocity, similar to a column of smoke in air, expanding radially as it does so. Some other analogies that come to mind are the pouring of cream slowly into a cup of black coffee or the flushing out of a fountain pen into a basin af water.

Although neither of these cases necessarily involves much if any density differences between the liquids in question, the turbulent mixing that take place is readily seen as the liquid jets enlarge.

It seems logical that the deeper an individual discharge opening is located and the greater the discharge velocity (especially if discharge is horizontally directed), the greater will be both the turbulence and the length of the path of the rising jet; hence, the greater will be the expansion of the jet in its rise to the surface and the greater the initial surface dilution of injected effluent. For maximum efficiency, multiple outlets should be separated sufficiently to prevent mingling of adjacent rising jets or so-called mutual interference before they reach the surface.

Another consideration in initial dilution is the supply of diluting water moving into the area of injection either by natural current or, to a lesser extent, by currents induced by the discharge itself. This may be a limiting factor.

Experimental data on initial dilution have been evaluated by Rawn and Palmer[5] and Houghton and Mason[12] and more recently have been re-evaluated by Rawn, Bowerman, and Brooks[13]. Discussions of these analyses and other pertinent diffusion studies is included in Pearson's report[1].

Following submarine injection of a given slug of sewage effluent and subsequent initial dilution during its ascent to the surface, the slug will tend to move away from the 'boil'" or point of surfacing. This movement may be due to the slug's kinetic energy and potential energy in the case of still water, but usually there is some ocean current present and if it is sufficiently strong, it will predominate in the movement of the sewage field.

An approximate analogy of the former condition would be the case of a thin stream of cream being poured into the cup of black coffee. For the latter case, a smokestack discharging into a wind would be analogous.

For still water conditions the spread of the field will be more or less radial; for conditions of current, the spread will be generally normal to the axis of the current. In either case, because of the diffusers constructed so far do not result in very great initial dilution of the effluent, the sewage field will generally tend to lie in a stratified mass at the surface and will diffuse more rapidly in a horizontal direction than a vertical one.

The entire process of diffusion of a sewage field and other phenomena that tend to dissipate the pollutants are quite complex. Aside from established formulas for dealing with oxygen sag, commendable attempts have been made to formulate mathematically the various other actions that occur. Notable among the formulas thus produced are those of Rawn and Palmer[5], Conway[9 14], Pomeroy[15], and Brooks[16]. Summaries of these formulas and several applications made of them are available in a recent separate report[17].

These formulas use different approaches to the problem as sewage

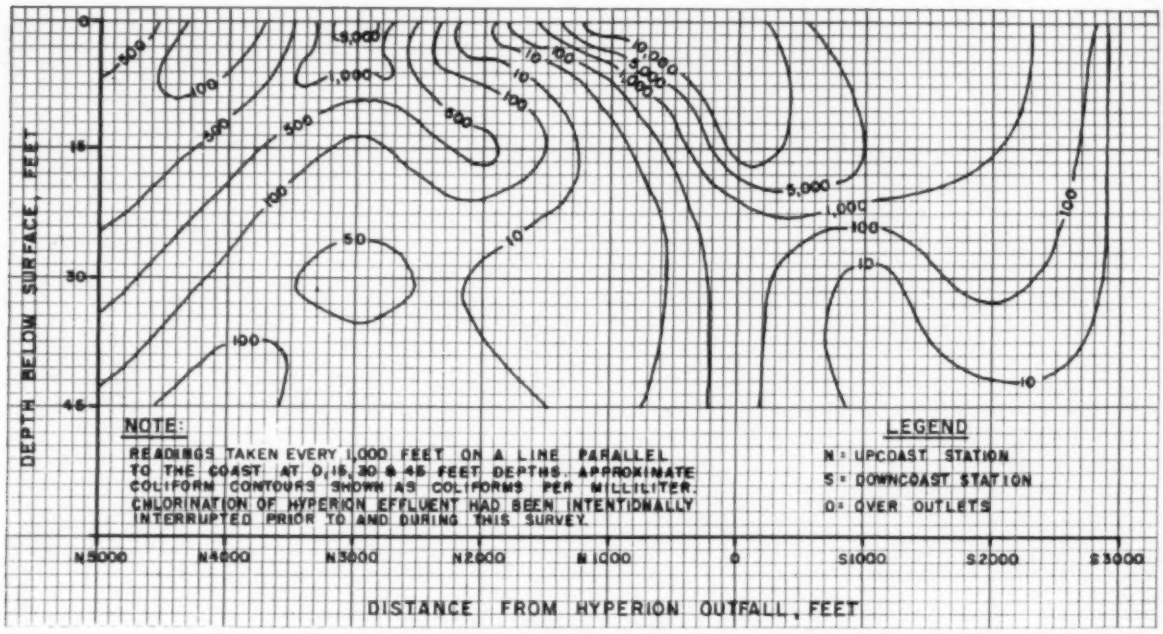


Fig. 3—PROFILE of densities of coliform organisms about one mile off shore, vicinity of Hyperion outfall on Jan. 12, 1956.

field spread and dissipation. In some the element of true physical dilution is separable from the other elements causing decline of bacteria and/or chemical pollutants. All attempt to show an over-all effect in the movement of the sewage field from its point of origin to some point offshore or at the beach.

Most of the formulas provide that local conditions may be incorporated into the equations in the form of constants. These constants may apply to current characteristics, ocean turbulence, bacterial decline rates, or net effects of some or all of these particular factors.

Offshore Dilution and Bacterial Studies

Physical diffusion itself does not always proceed as rapidly as one might expect, particularly where ocean turbulence is not pronounced, as is generally true of Santa Monica Bay. Figure 2 shows the results of dilutions computed by Hyperion Engineers from sampling data collected on a fairly recent survey by the Los Angeles Bureau of Sanitation in the area influenced by discharges of chlorinated high-rate activated sludge effluent from the existing 1-mile Hyperion outfall in Santa Monica Bay. The eight diffuser ports have an average submergence of 45 feet at mean sea level and the average flow of 245 mgd receives an average initial dilution of about 14 or 15.

The dilutions were computed on the basis of both chlorinity and free ammonia measurements in the surface waters. The dilution contours are approximate and especially those representing fairly high dilutions should not be considered necessarily accurate, in view of the earlier discussions in this paper.

The general spread of the sewage field in an upcoast direction is immediately evident. This pattern is typical for certain conditions encountered. It also appears that dilution of the field in the vicinity of the diffuser takes place more gradually in an offshore direction than in an onshore direction. One possible explanation is that a nearshore warm water wedge resulting from the Hyperion discharges, as well as circulation of cooling water from nearby steam power plants, tends to deflect or slow down some of the onshore movement of water masses.

It is interesting to note that the dilutions appear to decrease in the vicinity of the mouth of Ballona Creek, a stream that carries only a small flow during the dry seasons but fairly substantial flows following rains during the wet season. There had been light rains on four of the five days preceding the day of the survey. The last few thousand feet of the creek are tidal and a brackish discharge would result, hence accounting for a lower apparent dilution of the sewage field, based on chlorinity. Actually, the free ammonia counts in the area were appreciably higher than the background level for the bay. The dilutions computed from free ammonia were somewhat lower than those obtained by chlorinity, as was generally true of the bay during this survey.

Bacterial Decline

Probably the most important consideration in the disposal of sewage effluent into coastal waters near recreational areas is the reduction of bacterial densities to safe levels adequate for protection of the public health. This has been studied by many official agencies and private investigators.

It has gradually become apparent that the decline of bacteria is not entirely due to a bactericidal effect of sea water. Rather, this factor is somewhat less important than previously supposed, and other factors, notably sedimentation and dilution, may be of greater significance.

These findings are relatively recent. The separation and accounting for the extent of bacterial decline by the individual causes is difficult and has not yet been very well defined, although steps are being taken in that direction.

A stratified sewage field on the ocean's surface does not ordinarily diffuse downward very rapidly. However, even if the dissolved pollutants are not observed to move downward there may be a settling of particulate matter and associated bacteria. These phenomena may vary among varying effluents and receiving waters. Dilution itself may often by "patchy."

It is not unusual, therefore, to find that low bacterial densities are not al-

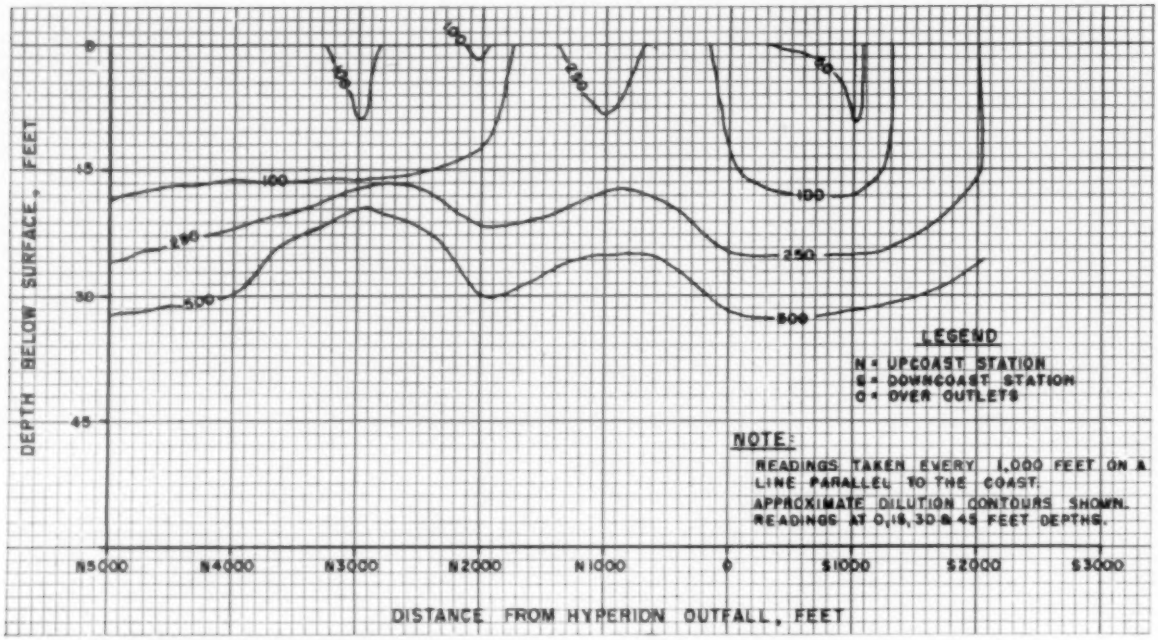


Fig. 4—PROFILE of chlorinity, measured dilutions about one mile off shore, vicinity of Hyperion outfall, Jan. 12, 1956.

ways found at points of high dilution and *vice versa*. Figures 3 and 4 are profiles of coliform density and dilution, respectively, drawn by Hyperion Engineers from data collected by the Hancock Foundation during a cruise through the Hyperion sewage field in early 1956 following an intentional interruption of chlorination of the effluent. It will be noted that there is a patchiness of dilution, but that the lower depths consistently contain the highest dilutions. It may also be seen that in some cases relatively low bacterial densities are accompanied by relatively high dilutions, but that at other points this is not true.

The general direction of the current (from right to left) is indicated by both profiles. The sagging coliform contours near the left side of Figure 3 suggest sedimentation of coliform bacteria, although the pattern is not as striking as has been observed at Orange County, Cal.[3].

Summary

Dilution of sewage effluent in sea water offers a convenient and satisfactory method of disposal for many coastal communities. The phenomena involved in the dilution of effluent by sea water through ocean outfalls and diffusers are complex and deserving of attention by engineering designers, particularly when efficiency is important.

In appraising performance of existing ocean outfalls, careful consideration should be given to the laboratory procedures adopted and their accuracy and significance. Considerable scientific and engineering knowledge has been and is being developed on the subject of ocean disposal of sewage wastes. This knowledge should prove valuable to the engineers and others engaged in the design and operation of ocean disposal works.

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From a survey of practice in Louisiana come recommendations for . . .

Sewer System Maintenance

by JAMES B. SMITH, Engineer, staff of Howard L. Heureux & Associates, Alexandria, La.

SEWER SYSTEM Maintenance is used here to mean the performance of those functions necessary for the operation and maintenance of the entire sewerage system and all of the component parts thereof. The term is used to include preventive maintenance, repair maintenance, routine operation, the keeping of repair records and cost data, as well as the creation and development of proper public relations in the community.

A study of 45 sewer systems throughout the State of Louisiana has been made in regards to the type of municipal government, the people of the community, operating personnel, type of organization, availability of financial support, and a number of other lesser factors.

Government and the People

Information was obtained in discussions with City officials, the City Clerk, and others familiar with the operations of each municipality in order to determine:

1. The type of government and the place of the sewer maintenance organization therein;
2. The attitude of officials and their knowledge relative to the sewer system and its maintenance;
3. The attitude of the people of the community, their knowledge of the sewer system, and their willingness to provide financial support.

Type of Government

The type of government and its relationship to maintenance is shown in Table 1.

The government of the municipality is beyond the scope of this study and beyond the control of the operator. However, it is interesting to note that the type of government has some bearing upon the maintenance of the sewer system. The commission form of government accounts for a higher percentage of *Excellent* conditions, and the mayor and council form of government accounts for a higher percentage of *poor* conditions. The separate sewerage board may provide the best maintenance; however, the information available is insufficient for definite conclusions.

It is also to be noted that *Excellent* maintenance is attainable under all of the forms of government, and that *Poor* maintenance is also found under each of the two generally used forms of government. Whereas the type of government has some bearing upon the maintenance of the system, there are other factors of much more importance.

Attitude and Knowledge of the Officials

Information on the attitude of officials and their knowledge of the system is summarized in Table 2.

As is evident in Table 2, the attitude of the officials and their knowledge of conditions relative to the sewer system and its maintenance are two of the most important factors affecting maintenance.

Many officials were encountered who were sufficiently interested in the system, but were unable to evaluate the conditions as found. In several such cases there was evidence leading to the conclusion that the official was being intentionally misled and misinformed as to the existence of unsatisfactory conditions.

In approximately 30 percent of the municipalities it was found that the officials were not sufficiently interested in the sewer system and its maintenance to warrant their visiting the plant, pumping stations, or other facilities. However, in the remaining 70 percent of the municipalities, a genuine interest on the part of the officials prevails, and in those cities the officials are fairly well informed.

Attitude and Knowledge of the People

The attitude of the people of the community, their knowledge of the sewer system, and their willingness to give financial support are factors which were extremely difficult to ascertain. However, in the people of the community rest the most important factors affecting maintenance.

TABLE 1

Type of Government	Condition of Sewer System			
	Excellent	Good	Fair	Poor
Separate Sewerage Board (1)	100%			
Mayor and Commissioners	43%	14	14	29
Mayor and Councilmen	25%	22	15	41

TABLE 2

Attitude and Knowledge of Officials	Condition of Sewer System			
	Excellent	Good	Fair	Poor
Proper Attitude and Sufficient Knowledge	43%	22	35	0
Improper Attitude and Insufficient Knowledge	0%	20	20	60

Ed. Note: This paper was presented at the Annual Louisiana short school and conference on Water Supply and Sewage. It is published here by permission.

The people of the community are the ones who are able to provide adequate facilities; the people of the community are the ones who are able to provide sufficient financial support for proper operation of the facilities.

As evidenced by questions among the city employees—the people most likely to know about the sewer system—it was found that, in general, the people of the community have very little knowledge of the sewer system and the problems of operating personnel. As evidenced by the bond issues that the voters have approved in recent years for improvements and extensions, it is apparent that, when intelligently informed of conditions, the people will provide funds for the construction of suitable facilities and for the maintenance of the system.

Operating Personnel

Discussions were held with operators and operating personnel in order to determine:

1. The knowledge and experience of the personnel;
2. Their attitude towards their work and their system;
3. The organization within which they operate.

Knowledge and Experience of Personnel

The knowledge and experience of personnel were found to be excellent in all but a few isolated cases. The superintendents, operators and permanent laborers, in general, have a very thorough knowledge of the work they are doing. The degree to which this knowledge extends was found to be dependent upon the extent of the facilities being operated. However, the knowledge of personnel in regards to the keeping of records, cost data and other information relative to the overall operation of the system was found to be lacking in far too many instances.

Attitude of Personnel

The attitude of personnel toward their work and their system was found to be as follows:

Excellent	37%
Good	27%
Fair	16%
Poor	20%

A correlation of the attitude of personnel and the condition of the maintenance of the system shows a direct relationship between the two factors. Proper attitude of personnel generally resulted in *excellent* or *good* conditions; improper attitude of personnel generally resulted in *fair* or *poor* conditions. In a number of instances, however, proper attitude of personnel was overcome or subdued by an inadequate system, insufficient maintenance funds, or political interference.

TABLE 3

Type of Organization	Condition of Sewer System			
	Excellent	Good	Fair	Poor
Sewer Maintenance Combined with Other Utilities	6%	17	60	17
Separate Sewer Maintenance	56%	25	13	6
Agreements with Plumbers	—	—	50	50

The Organization

The organization within which personnel operated was found to be as diversified as the municipalities themselves. In 50 per cent of the cities, the maintenance of the sewer system is combined with other utilities; in 43 per cent of the cities maintenance of the sewer system is performed by a separate organization; and in 7 per cent of the cities maintenance is performed through working agreements with local plumbers.

The condition of the sewer system relative to the type of organization is shown in Table 3.

It is clearly evident from Table 3 that a separate organization is the best method of obtaining satisfactory maintenance of the sewer system.

Cost Data

Data were obtained from the various City Clerks, or other appropriate official, as to:

1. The availibility of cost data;
2. The completeness and clarity of cost data;
3. The amount of expenditures for sewer maintenance.

Availability of Cost Data

It was found that 50 per cent of the municipalities keep records of cost of sewer maintenance. The remaining cities combine sewer costs with water, gas, streets, or other accounts. Of the cities keeping separate cost data, 50% do not separate the maintenance costs from the costs of making extensions to the system.

Completeness and Clarity of Cost Data

Of those municipalities with separate cost data, the vast majority were found to have fairly complete records. However, the method of breaking down the costs was found to be as diversified as the accountants who audit the cities' books. Consequently, the accounts have been set up primarily for the checking of funds, rather than for the comparison of costs with the results of operation and maintenance.

Expenditures for maintenance of the sewer system have been calculated on the basis of cost per capita annually.

Three all-gravity systems in towns of approximately 2500 population are being operated at a cost varying from nothing to 30 cents per capita annually.

In the cities requiring pumping and/or treatment of the sewage, some slight variation in costs resulted, depending upon the amount of pumping, the number and sizes of stations, and the type and degree of treatment. However, in general, costs of maintenance varied from $1.00 to $2.10 per capita annually.

Excellent conditions exist in those cities spending $1.50 to $2.10 per capita annually.

Good or *fair* conditions exist in those cities spending $1.00 to $1.50 per capita annually.

One city spends $2.00 per capita annually yet receives poor maintenance. However, such conditions are due primarily to faulty design and construction, an overloaded system, improper organization, and operating personnel having none of the technical knowledge required by the situation.

Of the cities studied, 50 per cent collect a monthly service charge; 20 per cent are in the process of starting the collection of such a charge; the remaining 30 per cent depend upon other means of financing operation of the system.

A great majority of the cities spending $1.00 or more per capita annually have in effect a monthly service charge. All of the cities spending less than $1.00 per capita annually obtain funds from other sources.

A direct relationship exists between the amount spent for maintenance and the manner in which funds are obtained, with the monthly service charge giving the best results in all cities using such method.

Inspection

A study of the sewer systems was made relative to:

1. Design;
2. Construction;
3. Maintenance.

Design

The study and inspection of the systems reveal a great need for improvements in the design of such facilities. Many of the operators' troubles are the direct result of inadequate design, and failure on the part of the engineer to consider the operation and maintenance of the component parts of the facilities. Following are listed some of the deficiencies noted:

1. Placement of bar screens and baskets in inaccessible locations;
2. Improper illumination, or complete absence of illumination, in pump pits and other locations requiring maintenance of equipment;
3. Improper ventilation of wet wells, pump pits, and other locations where the collection of odors and gases is likely;
4. Installation of equipment in inaccessible locations;
5. Omission of grit chambers preceding treatment plant equipment;
6. Use of delicate and complicated pump control equipment and flow indicating and recording equipment instead of simple, rugged and easy-to-maintain types;
7. Omission of fencing where necessary for the protection of the plant, equipment and the public;
8. Omission of floodlighting necessary for night operation and maintenance; and
9. Omission of painting of pumping stations and treatment plants.

Construction

Poor construction of sewer system facilities by the contractor as a result of the lack of, or complete absence of, proper inspection during construction was found to account for many of the problems confronting the operator.

Eighty percent of the systems have excessive infiltration due to faulty joints in the lines.

Thirty per cent of the systems have excessive amounts of sand getting into the lines and into the treatment plant.

Maintenance

The maintenance of the systems inspected was judged as follows:

Excellent	30%
Good	20%
Fair	36%
Poor	14%

Better Maintenance

In view of the foregoing, what can the individual superintendent or operator do in order to better the maintenance of his sewer system?

1. Analyze your own situation, the quality of your own maintenance, the type of government of your municipality, the attitude and interest in the system on the part of the officials and the people of the community. Analyze the knowledge, experience and attitude of your personnel and of yourself. Study your organization, its place in the organization of the city government, and its place in the community. Analyze your method of keeping records, of keeping cost data pertaining to operations, and the amount your maintenance is costing annually per capita. Check on the design and construction of your system. If already constructed, study possible methods of correcting deficiencies in design and construction. If under construction, correct the deficiencies before it is too late;

2. Visit other plants. Disuss your sewer maintenance problems with other operators. Compare your maintenance with the others;

3. Broaden your knowledge of your system in order that you may, in turn, broaden the knowledge of the officials and the people of your community;

4. Never overlook an opportunity to enlighten the people of the community in regards to the sewer system. Your greatest help and assistance may be derived from an educated and informed public;

5. Have the officials subscribe to one or two of the sewerage works journals. By the reading of such literature you and your personnel will become better informed;

6. If your maintenance organization is presently combined with other utilities, separate them;

7. Work with your City Clerk in order to set up a method of keeping the cost data on your maintenance. If such cost data are presently combined with other utilities, have them separated;

8. If your maintenance costs are presently combined with the cost of making extensions and other improvements to capital investment, have them kept separately;

9. If your municipality presently has no monthly sewer service charge, start working toward the securing of such a charge;

10. Set a goal on the amount of funds to be budgeted and used for the maintenance of the system. Generally, $2.00 per capita annually will do for a start. Work to obtain that amount;

11. Check the design of all new facilities with the consulting engineer before the bids are to be received. Then check on the construction of the facilities with the engineer as the work is in progress;

12. Conduct a cleanup and paint-up campaign for your treatment plant and pumping stations. Clean facilities are well maintained facilities.

When all of the foregoing has been accomplished, you and your personnel will have made your system one of which you can be justly proud.

Dr. Ira P. Macnab Retires at Halifax

Dr. Ira P. Macnab, general manager of the Halifax Public Service Commission retired from that position this month. Dr. Macnab was active in the Canadian Section of the AWWA and helped organize the Maritime Branch in 1948. He was the first president of the branch.

Prior to his appointment to the position of general manager, he was a member of the Board of Commissioners of Public Utilities of Nova Scotia. He has always been active in engineering work; is a past president of the Dominion Council and a past president of the Engineering Institute of Canada. He has received the George Warren Fuller Award from AWWA and an honorary LL.D. (Honoris causa) from Mount Allison University and a Doctor of Engineering from the Nova Scotia Technical College.

At the meeting of the Maritime Branch of the Canadian Section of AWWA, an illuminated scroll was presented to Dr. Macnab as a token of the high-esteem and in commendation and thanks for his untiring efforts towards the formation of the Maritime Branch. In order to perpetuate the esteem in which Dr. Macnab was held, the branch has established an annual award to be known as the "Macnab Award" which may be presented annually if it is deemed that this honor is merited for outstanding service by any person actively engaged in the water works field in the Maritimes.

The editor's comments

New Blood

Last month, Kenneth Watson, FSIWA President, reviewed the progress in sewage works during 1957. One paragraph in that review deserves comment.

Mr. Watson wrote, "A major question existed at the beginning of 1957 and it is still very much present to plague the thinking people in the field.—What is to be the source in adequate numbers of competent and qualified personnel, with potential upgrading the field, to man the rapidly expanding assignments of the future? Insufficient numbers of youngsters are enrolling in engineering schools . . . our problem is further complicated by the fact that the waste control field is not attracting the proportion of these engineers that should reasonably be expected."

Mr. Watson wrote about the waste control field, but his words apply equally well to the water works industry. It is a situation which has existed for many years and unfortunately it shows few signs of improvement.

I remember when "Vic" Weir (Pres., St. Louis County Water Co.) was inaugurated president of AWWA in 1948, he commented on the lack of young blood in the water works profession. At that time Mr. Weir said that the average age of technical personnel in the water works industry was 48 years. It is my guess that the age limit is higher now.

I don't recall whether Mr. Weir also said that the average salary of technical men in the field was considerably less than offered in industry, but he could have said it without fear of contradiction and that statement is even more true today.

Mr. Watson suggested that "everyone in the field must become concerned with the fact that too few technical men are being drawn to it" and he continued that "a much better public relations job must be done and the sanitary engineering colleges must explore the approaches by which they can more nearly fill their classes."

One of the best approaches to the problem is to raise the salary level of men in both water and sewage works. Make the financial return comparable to industry and there will be adequate personnel attracted to it.

New Units

The Board of Control of the Federation of Sewage and Industrial Wastes Assns. now has before it for consideration the final report of a subcommittee on Standardization of Units. The report is titled "Revised Report on Recommended Units of Expression for Design and Operation of Sewage and Industrial Waste Treatment Plants." After several years' work this subcommittee presented its original report in late 1956 and the report was published in the February, 1957, issue of *Sewage & Industrial Wastes.*

The original (1956) report recommended one significant change in the unit for waste volume, namely cubic feet instead of gallons in volume and flow units. This change made possible many simplifications in the units proposed. Objections received were not overwhelming but it did appear that the recommendation was controversial. Therefore the committee reconsidered its action last October and now recommends the adoption of the standard units using gallons instead of cubic feet as a unit of volume and flow.

The Subcommittee also recommended that efforts be continued for the adoption of the cubic feet unit and that this work be done in conjunction with ASCE, AWWA, APHA and ASTM.

The Subcommittee further recommended that the new proposed standard units be reviewed and revised periodically as necessary and that the units be used in presenting material published in technical journals.

When these proposed standard units are published in the official Journal of the Federation, *Water & Sewage Works* will begin to use the units in all articles where they apply. Wherever possible the older units will be included in parenthesis until the new units become familiar to readers.

The Value of Water

When persons outside our industry begin to talk about how valuable is water, it is time for us in the industry to become even more cognizant of the problem.

Last May, Walter Murphy, Editorial Director of the American Chemical Society, Applied Journals, wrote an editorial on the subject. Here are some of his words: "Water is one of our most precious resources, but relatively few people know it. Few realize that our future industrial growth will be deterred unless we find ways of providing ever increasing amounts of water . . . we have not yet been forced to place enough value on water to justify needed engineering expenditures. There probably will come a time in many areas when we will gladly pay for this essential commodity in proportion to its true value to us . . . with our expected population of well over 200 million by 1975, we must find the answers—not 25 years hence, but within a few years."

It is good to know that one voice in the chemical industry is echoing the words of John H. Murdoch, Jr. when he said "we have had 75 years of too cheap water," but we in the industry must continue our efforts, public relationwise, to acquaint the public, industry and agriculture with the real value of water.

George E. Symons.

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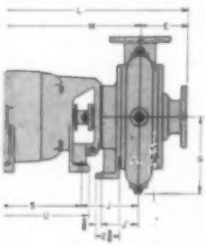

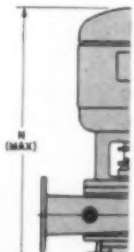

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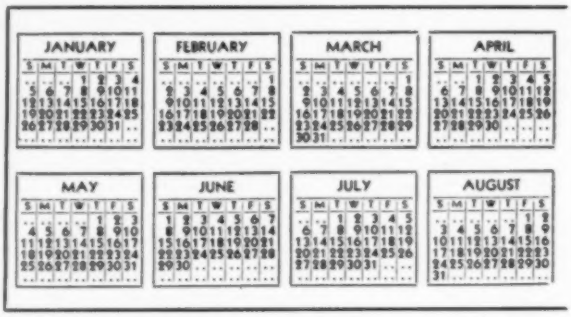
Meetings

1958



Mar. 12-14—Atlantic City, N. J. *(Traymore Hotel)*
NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Michael S. Kachorsky, P. O. Box 68, Manville, N. J.

Mar. 12-14—Salina, Kansas *(Lamer Hotel)*
KANSAS SECTION, A.W.W.A., Secy., Harry W. Badley, Neptune Meter Co., 119 W. Cloud St., Salina, Kan.

Mar. 12-14—Baton Rouge, La. *(Louisiana State University)*
21ST ANNUAL SHORT COURSE FOR SUPTS. & OPERATORS OF WATER AND SEWERAGE SYSTEMS, Secy., Geo. H. West, P. O. Box 15, Water Dept., Lake Charles, La.

Mar. 20—Boston, Mass. *(Hotel Statler)*
NEW ENGLAND WATER WORKS ASSN., Secy., Joseph C. Knox, 73, Tremont St., Boston 8, Mass.

Mar. 20-22—Missoula, Mont. *(Florence Hotel)*
MONTANA SECTION, A.W.W.A., Secy., Arthur W. Clarkson, Asst. Director, Div. of Env. Sanitation, Montana Board of Health, Helena, Mont.
(Jointly With)
MONTANA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Harvey W. Taylor, c/o Morrison & Maierle, Inc., Helena, Mont.

Mar. 23-26—Atlanta, Ga. *(Dinkler-Plaza)*
SOUTHEASTERN SECTION, A.W.W.A., Secy., N. M., deJarnette, Engr., Div. of Water Pollution Cont., State Dept. of Health, 245 State Office Bldg., Atlanta 3, Ga.

Mar. 24-26—Fayetteville, Ark. *(University of Ark.)*
ARKANSAS WATER & SEWAGE CONFERENCE, Secy., C. W. Oxford, University of Arkansas, Fayetteville, Ark.

Mar. 26-28—Schenectady, N. Y. *(Van Curler Hotel)*
NEW YORK SECTION, A.W.W.A., Secy., Kimball Blanchard, 19 West 50th St., New York 20, N. Y.

Mar. 26-28—Chicago, Ill. *(LaSalle Hotel)*
ILLINOIS SECTION, A.W.W.A., Secy., Dewey W. Johnson, Cast Iron Pipe Res. Assn., 3440 Prudential Plaza, Chicago 1, Ill.

Apr. 10—Oakland, Maine
MAINE WATER UTILITIES ASSN., Secy., Gerard F. Laurin, 89 Western Ave., Augusta, Maine

Apr. 16-18—Lincoln, Neb. *(Cornhusker Hotel)*
NEBRASKA SECTION, A.W.W.A., Secy., John E. Olsson, 408 Sharp Bldg., Lincoln, Neb.

Apr. 17—West Springfield, Mass.
NEW ENGLAND WATER WORKS ASSN., Secy., Joseph C. Knox, 73 Tremont Street, Boston 8, Mass.

Apr. 18—Harrisburg, Pa. *(Penn-Harris Hotel)*
ANNUAL CLEAN STREAMS CONFERENCE, Secy., R. V. Wall, Pa. State Chamber of Commerce, State Chamber Bldg., Harrisburg, Pa.

Apr. 20-25—Dallas, Tex. *(Memorial Auditorium)*
A.W.W.A. CONVENTION, Secy., Harry E. Jordan, American Water Works Assn., 2 Park Ave., New York 16, N. Y.

Apr. 20-25—Dallas, Tex. *(Memorial Auditorium)*
SOUTHWEST SECTION, A.W.W.A., Meeting in Conjunction with National Convention A.W.W.A., Secy., Leslie A. Jackson, Municipal Water Works, Robinson Memorial Auditorium, Little Rock, Ark.

Apr. 23-26—Stockton, Calif. *(Hotel Stockton)*
CALIFORNIA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Robert J. Barletta, 719 South Loara St., Anaheim, Calif.

Apr. 28-29—Roanoke, Va. *(Hotel Roanoke)*
VIRGINIA INDUSTRIAL WASTES & SEWAGE WORKS ASSN., Secy., O. J. Hand, c/o Hercules Powder Co., Hopewell, Va.

May 5-7—Lafayette, Ind. *(Purdue University)*
13TH PURDUE INDUSTRIAL WASTE CONFERENCE, Chairman, Prof. Don E. Bloodgood, Purdue University, Lafayette, Ind.

May 5-7—Lafayette, Ind. *(Purdue University)*
CENTRAL STATES SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Scott E. Linsley, P. O. Box 3598, St. Paul 1, Minn.

May 15—Brattleboro, Vermont
NEW ENGLAND WATER WORKS ASSN., Secy., Joseph C. Knox, 73 Tremont Street, Boston 8, Mass.

May 15-17—Spokane, Wash. *(Davenport Hotel)*
PACIFIC NORTHWEST SECTION, A.W.W.A., Secy., Fred D. Jones, Asst. Supt., Water Dept., 306 City Hall, Spokane, Wash.

May 15-17—Tucson, Ariz. *(El Conquistador Guest Hotel)*
ARIZONA SECTION, A.W.W.A., and ARIZONA SEWAGE & WATER WORKS ASSN., Joint Meeting, Secy., Stanford I. Roth, 813 E. Jefferson, Phoenix, Ariz.

May 18-24—San Juan, Porto Rico
6TH CONGRESS OF INTER-AMERICAN ASSN. OF SANITARY ENGINEERING, Secy.-Gen., Enrique Ortega, Apartado 218, San Juan 2, P. R.

June 2-4—Toronto, Canada *(Royal York Hotel)*
CANADIAN SECTION, A.W.W.A., Secy., A. E. Berry, Ontario Water Resources, Parliament Buildings, Toronto, Ontario, Can.

June 4-5—Gardner, Mass. *(Colonial Hotel)*
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Earl R. Howard, 115 Broad St., Hartford 5, Conn.

June 9-11—Auburn, Ala. *(Ala. Poly. Inst.)*
ALABAMA WATER & SEWAGE ASSN., Short Course, Secy., Prof. Robert T. Tindal, University of Ala., University, Ala.

June 12—Belfast, Maine
MAINE WATER UTILITIES ASSN., Secy., Gerard F. Laurin, 89 Western Ave., Augusta, Maine

June 12-13—Frederick, Md. *(Francis Scott Key Hotel)*
MARYLAND-DELAWARE WATER & SEWAGE ASSN., Secy., W. M. Bingley, 2411 N. Charles St., Baltimore 18, Md.

June 18—Swampscott, Mass. *(New Ocean House)*
NEW ENGLAND WATER WORKS ASSN., Secy., Joseph C. Knox, 73 Tremont Street, Boston 8, Mass.

June 18-20—Toledo, Ohio *(Commodore Perry Hotel)*
OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT CONFERENCE, Secy., Cleamon E. Lay, 301 Ohio Departments Bldg., Columbus 15, Ohio

One-Piece Aluminum Guides and Stop Plates

Mean Easy Installation, Greater Economy!

No more riveted flat bar assemblies or machined grooves. Our standard design stop plates and guides and slide gates and guides cost less . . . are *non-corrosive!*

Strong, durable, non-corrosive qualities of Aluminum make it important to Water and Sewage. *Washington Aluminum Engineers are available for discussion of design problems at point of planning at no obligation.* For fabrication information on *any aluminum installation,* write for nearest *representative.*

WASHINGTON ALUMINUM COMPANY, Inc.

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PHOTOVOLT pH METER MODEL 85

A Full-Fledged Line-Operated pH Meter at $105.–

including set of electrodes; available also with combination electrode at $108.–

No batteries to replace

Simple in operation

Dependable in service

Full pH range 0-14
3" scale, readable to 0.1
Available with carrying case

Usable with all types of electrodes, swing-arm adapter, polarization adapter for Karl Fischer titrations, electrode extension cables, etc.

Write for Bull. 195

PHOTOVOLT CORP.
95 Madison Avenue New York 16, N. Y.

Equipment News

CONTINUED FROM PAGE 28A

Light Trenching Machine

325

The Charles Machine Works, Inc., Perry, Okla., has developed a new self-propelled light trenching machine, the model C Ditch Witch.

The new machine is powered by a 7 hp air cooled gasoline engine and will dig a trench 3, 4½, or 6 in wide to depths up to 2 ft. Trenching speed is about 4 ft per minute.

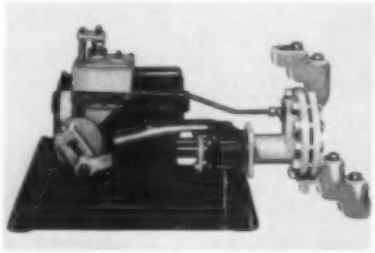
Completely mobile under its own power, the C trencher is easily handled on the job by one man. It is small enough (34 in wide) to go through a standard width gate for work inside fenced yards.

Controlled Volume Diaphragm Pump

326

Milton Roy Co., Philadelphia, Pa., has introduced a new controlled volume diaphragm pump for metering toxic, obnoxious, corrosive and/or other costly chemicals.

Retaining the step-valve liquid end and other features of the Milton Roy standard line, these new pumps have



Teflon diaphragms sealing the liquid ends from the plunger and housing. Accurate to within ± one percent, they are positive displacement metering pumps. The plunger displaces hydraulic fluid which in turn strokes the diaphragm to impart pumping action through double ball checks. There is no mechanical connection between the diaphragm and the plunger.

Blower—Compressors

327

Cyclo Blower Co., York, Pa. has available a line of axial-flow, blower—compressors that includes eight models, newly designed for either pressure or vacuum service. Capacities are from under 100 to nearly 3,500 cfm. Pressure range is from 3 to 15 psig; vacuum range from 5 to 20 inches of mercury. Air, steam or other gas may be handled.

Heart of the Cyclo Blower is a mating pair of screw-type rotors, which trap incoming air between their lobes and grooves. As the rotors turn, the air is compressed into smaller and smaller pockets until its discharge at the outlet end. Since the rotors do not touch, there is no wear and no need for lubrication within the compression chamber, assuring the delivery of oil-free air or gas. By interrupting the continuity of the rotor seals, Cyclo Blower eliminates the effect of shock, temperature rise and loading due to too rapid build-up of pressure. Its design also allows increased water rates for wet compression and vacuum service. The rugged housing,

CONTINUED ON PAGE 98A

NOW

LOW-COST AUTOMATIC FLOW RECORDING

Directly Readable Flow Charts

Obtain graphic records of liquid flow directly readable in million gallons per day or gallons per minute over various sizes of Parshall flumes. The same recorder can also be used with charts reading in feet and hundredths to record head or surface fluctuations in lakes, streams, wells. Write for free Bulletin 24.

STEVENS

TYPE F RECORDER

...For Measuring Sewage, Industrial Waste and Other Flows

The planning and efficient operation of any project which involves measurements of flowing liquids is based on flow data which can be obtained with STEVENS Recorders. These instruments are at work compiling data on hydroelectric and flood control projects and in water works, sewage disposal plants, irrigation and industrial installations in all parts of the world.

Experienced technical staff available to supply product information for liquid measurement installations. Write, giving description of project and scope of data desired.

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144 pages of technical data on recorder installations, plus a wealth of hydraulic tables and conversion tables. $1 copy. (No COD's.)

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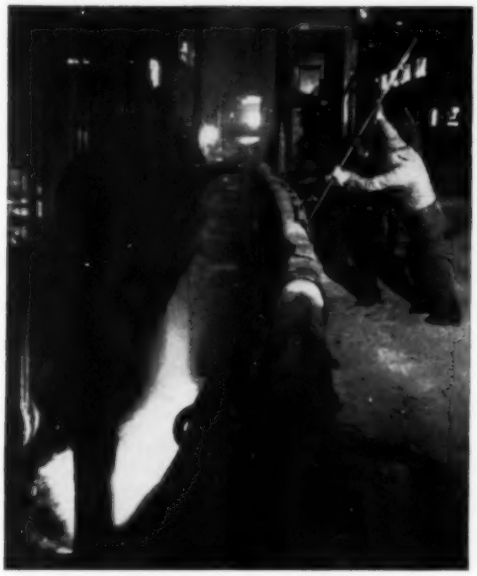
specialists in hydrologic instruments for over half a century



Increasing deoxidation—a key step in the manufacture of new 4-D Wrought Iron.

Now—from Byers Research—
an even better Wrought Iron
for modern corrosion control—

new 4-D wrought iron

Out of the laboratory and into production comes a newly formulated Wrought Iron to strengthen man's arsenal of corrosion resistant weapons.

New 4-D Wrought Iron is at least 25% *more* corrosion resistant than standard Wrought Iron—long an industry standard for superior corrosion resistance. This significant metallurgical advance is the result of 17 years of continuing research by Byers metallurgists.

And here's what it means to you.

Seventeen-year in-service and laboratory tests prove that 4-D Wrought Iron is superior not only to standard Wrought Iron, but has much greater corrosion resistance than other materials which are sometimes offered as substitutes. Thus, the economy of using standard Wrought Iron can now be compounded through the use of new 4-D Wrought Iron.

In addition to increased corrosion resistance, new 4-D Wrought Iron has greater uniformity and improved physical and mechanical properties. This is attained by substantially increasing the deoxidation of the base metal, increasing its phosphorous content, and using a more siliceous slag.

And the price of new 4-D Wrought Iron? No increase. Despite higher production costs, the price of Wrought Iron will remain the same.

Write us for new 4-D Wrought Iron literature, or contact the Byers representative for complete details. A. M. Byers Company, Clark Building, Pittsburgh 22, Pa.

BYERS Wrought Iron Tubular and Hot Rolled Products

ALSO ELECTRIC FURNACE AMBALLOY STEEL PRODUCTS AND PVC PIPE

Corrosion costs you more than Wrought Iron

Bulletins News

CONTINUED FROM PAGE 96A

providing high strength to resist deflection, assures proper positioning of the rotors through every operating pressure.

Each blower can be operated at high speed (up to 4,000 rpm for smallest blower). Since air-moving capacity increases with speed, high capacity is thus provided at relatively low unit weight. Direct or step-up drives permit the unit to be driven by less expensive standard motors.

Explosion-Proof Motors

328

Fairbanks, Morse & Co., Chicago, Ill., has introduced a new line of totally enclosed, Explosion-Proof Motors. Designed to eliminate fires or explosions when motors must be operated in combustible or explosive atmospheres, these motors incorporate several new features.

Offered in both fan-cooled and non-ventilated models, these F-M motors are all manufactured in strict accordance with latest NEMA standards, and bear the Underwriters Laboratories Approved Labels.

Fairbanks-Morse Explosion-Proof fan-cooled motors, manufactured in rating of 1½ to 30 hp., incorporate a unique and extremely efficient cooling system.

Trapped clean air within the motor enclosure is transferred by rotor action to the large frame and bearing arm surfaces. A cooling air system, supplied by an external aluminum fan, is directed by a carefully designed fan shield over the motor surface to dissipate this heat. The air stream is confined close to the surface of the motor to eliminate hot spots, and prevents the accumulation of dust and dirt. The numerous small openings on air intakes provide for an ample flow of cooling air, but prevents large foreign objects from being drawn in by the fan.

Gate Valves

329

Kennedy Valve Mfg. Co., Elmira, N. Y. has available A.W.W.A. Standard Iron-Body Double-Disc Gate Valve with O-Ring construction and mechanical joint ends.

The two O-Ring Seals are Buna N synthetic rubber compound of 70 Durometer hardness. These are assembled into the Kennedy Higher-Strength Cast Iron Stuffing Box which forms the top thrust bearing for the stem collar. The stuffing box is secured to the valve bonnet with rust-proofed steel bolts. The top O-Ring is the dirt seal. The lower O-Ring is the pressure seal eliminating any need of further adjustment. O-Rings provide an excellent seal preventing any binding of the stem and resulting in very easy valve operation.

Mechanical joint ends are available in sizes 3″ through 14″. Kennedy can supply valves with Mechanical Joint Ends through 48″ sizes.

These valves have inside screw, non-rising stem and paralleled seats. Working pressures are: 12″ and smaller, 200 lbs. cold water; 14″ and larger, 150 lbs. cold water.

the leader in
water chlorination for over 30 years

Use HTH in either form for sure elimination of bacteria, algae, fungi and odors from reservoirs, wells, mains, spray ponds, filters and other danger spots.

HTH Granular—Free-flowing, fast-dissolving. Packed in 100-lb. lithographed steel drums and in cases of nine 5-lb. cans.

HTH Tablets—Slow-dissolving chlorine in its most modern form. Packed in 100-lb. drums and in cases of twelve 3¼-lb. cans.

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HTH
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INDUSTRIAL CHEMICALS DIVISION • BALTIMORE 3, MD.

5881

How to select the right flow-measuring device

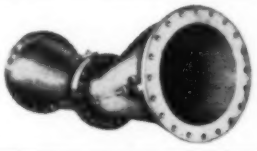
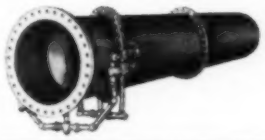
Selecting the correct device is simply a matter of choosing the one that best meets your requirements. The wide variety of Simplex Primary Elements makes this selection easy.

This table shows you which of Simplex's standard elements performs best under various flow conditions. (Not shown are Simplex primary devices of steel or concrete, designed to meet the physical limitations on special jobs.)

SIMPLEX VENTURI TUBES produce a minimum head loss—returning 85% to 90% of the differential head developed for meter operation. Since pressure differentials are measured between the main and throat sections, the tubes are smooth, true in shape and of accurate diameters to produce a stable coefficient of discharge. This gives you accuracy over wide flow ranges . . . accuracy within ±0.3% if required.

Write for Technical Bulletins. Simplex Valve & Meter Co., Dept. WS-3, 7 East Orange Street, Lancaster, Pa.

SIMPLEX®
VALVE AND METER COMPANY
VENTURI TUBES • FLUMES • METERS • GAUGES
TRANSMITTERS • CONTROLLERS • TABLES • AIR VALVES

FLOW CONDITION		SOLUTION
NORMAL WATER, AIR OR GAS FLOWS		TYPE VT—STANDARD VENTURI TUBES Cast iron with bronze bushed main piezometer holes and bronze throat liner. Flanged, bell or spigot ends. Inspection opening at throat. Special metals for high pressures or caustic liquors, corrosive gases, brines, etc. BULLETIN 005
NORMAL WATER, AIR OR GAS FLOWS		TYPE TG—INSERT TUBES AND NOZZLES Withstand high pressures. Fit inside existing lines . . . permitting light construction. This, plus *short length*, cuts costs. BULLETIN 100
SMALL FLOWS OF WATER, GASES CORROSIVE FLUIDS		TYPE TF—MINIATURE VENTURI TUBES Machining to .0005" assures accuracy. Main diameters as low as ½"; throat diameters down to .1". Welded stainless steel models for high pressures. BROCHURE
NORMAL SEWAGE, SLUDGE, TRADE WASTES		TYPE VTJ—SINGLE TAP VENTURI TUBES Single taps at main and throat have bayonet-type valve for fast cleaning. Absence of pressure belts prevents clogging. Inspection opening at throat. BULLETIN 005
NORMAL SEWAGE, SLUDGE, TRADE WASTES		TYPE VS—FOUR TAP VENTURI TUBES Four cleaning valves at main and throat can be operated manually, by air, or hydraulically to keep piezometer holes clear for top accuracy. Two hand holes on each pressure belt and inspection opening at throat. BULLETIN 005
LOW-VELOCITY SEWAGE, HEAVY WASTES		TYPE VE—ELLIPTICAL VENTURI TUBES Developed specifically to accurately measure low-velocity sewage, sludge and heavy trade wastes—under low pressures. *Flat top* prevents air binding. *Flat bottom* is self-scouring. Inspection opening at throat. BROCHURE
LOW-HEAD SEWAGE, SLUDGE, TRADE WASTES		TYPE S—PARABOLIC FLUMES Full 20:1 range for open flows. Accuracy ±2%. Flanged, bell or spigot inlet for 6 to 36" lines. Integral sediment trap, piezometer reamer, gauge glass, direct-reading flow scale. BULLETIN 801

New Bulletins

CONTINUED FROM PAGE 30A

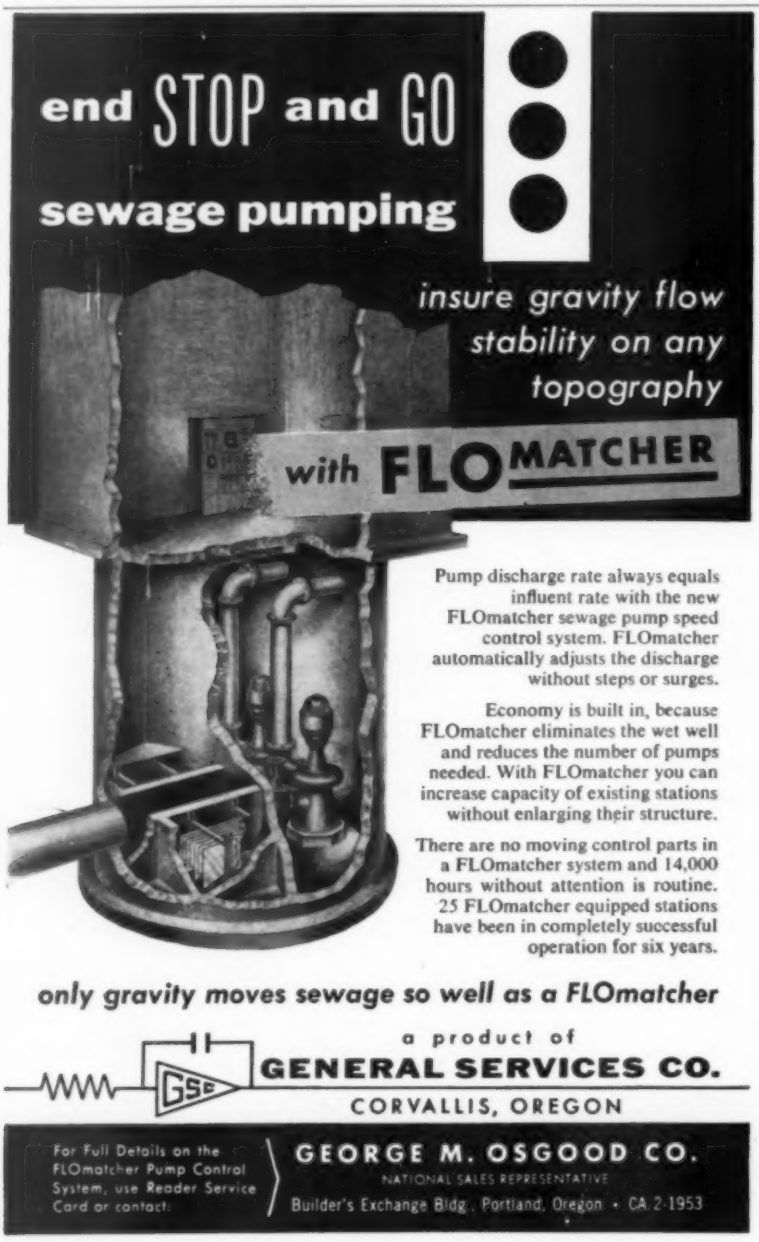
Single-Home Sewage Treatment System

330

Yeomans Brothers Co., Melrose Park, Ill., has available a bulletin describing and illustrating the Cavitette, the single-home sewage treatment system.

The bulletin describes the Cavitette as a miniature, self-contained sewage plant, not a septic tank system. The unit consists of a vertical draft tube with lower diffusion plate. The rotor assembly is of the multi-blade type, mechanically balanced and supported by means of a ball-thrust bearing mounted at motor level.

Complete operation, installation, and specification data are given in the bulletin. Cut-away drawings show operational details and proper installation techniques.


end STOP and GO
sewage pumping
insure gravity flow
stability on any
topography
with FLOMATCHER
Pump discharge rate always equals influent rate with the new FLOmatcher sewage pump speed control system. FLOmatcher automatically adjusts the discharge without steps or surges.
Economy is built in, because FLOmatcher eliminates the wet well and reduces the number of pumps needed. With FLOmatcher you can increase capacity of existing stations without enlarging their structure.
There are no moving control parts in a FLOmatcher system and 14,000 hours without attention is routine. 25 FLOmatcher equipped stations have been in completely successful operation for six years.
only gravity moves sewage so well as a FLOmatcher
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GENERAL SERVICES CO.
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For Full Details on the FLOmatcher Pump Control System, use Reader Service Card or contact:
GEORGE M. OSGOOD CO.
NATIONAL SALES REPRESENTATIVE
Builder's Exchange Bldg., Portland, Oregon • CA 2-1953

Atomic Water Treatment

331

Hungerford & Terry, Inc., Clayton, N. J., has available for distribution a booklet called "Atomic Kilowatts".

The booklet tells the story of water treatment at the Duquesne Light Company Plant at Shippingport, Pa. The water conditioning equipment for this first full size stationary civilian nuclear power plant was designed and manufactured by Hungerford & Terry.

Mixed Flow Pumps

332

Economy Pump Div., C. H. Wheeler Manufacturing Co., Philadelphia, Pa., has released a new twelve-page, 2-color catalog describing axial and mixed flow vertical and horizontal pumps.

To assist in proper applications, construction and design details, station arrangement suggestions and illustrations of a number of typical installations have been included in this catalog. Pull-Out Type Units, designed so that all rotating parts, the diffuser, impeller housing and suction bell can be removed without disturbing discharge or floor plate connections, are also described.

Ring Balance Meters

333

Hagan Chemicals & Controls, Inc., Pittsburgh, Pa., has just released a new eight-page bulletin listing performance and specification data for series 3000 Ring Balance Meters and available accessories.

The bulletin, according to the company, is the most comprehensive technical brochure produced thus far on the versatile single ring meter series. It contains descriptive text, tables and illustrations on such accessories as integrators, pneumatic transmitters, and pressure and temperature elements.

Some 47 maximum accessory combinations of the ring balance meter are shown in a full page listing. These include adaptations for automatic temperature and pressure compensation, slide wire transmission and electronic receiving.

Besides accessory data, the bulletin lists different meter rings available for varying performance requirements

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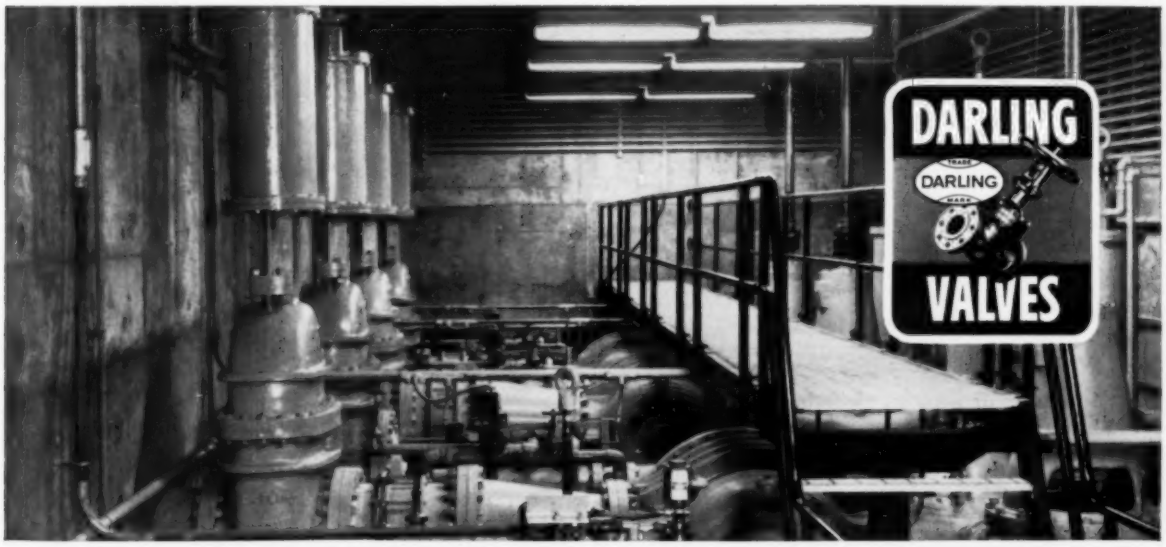

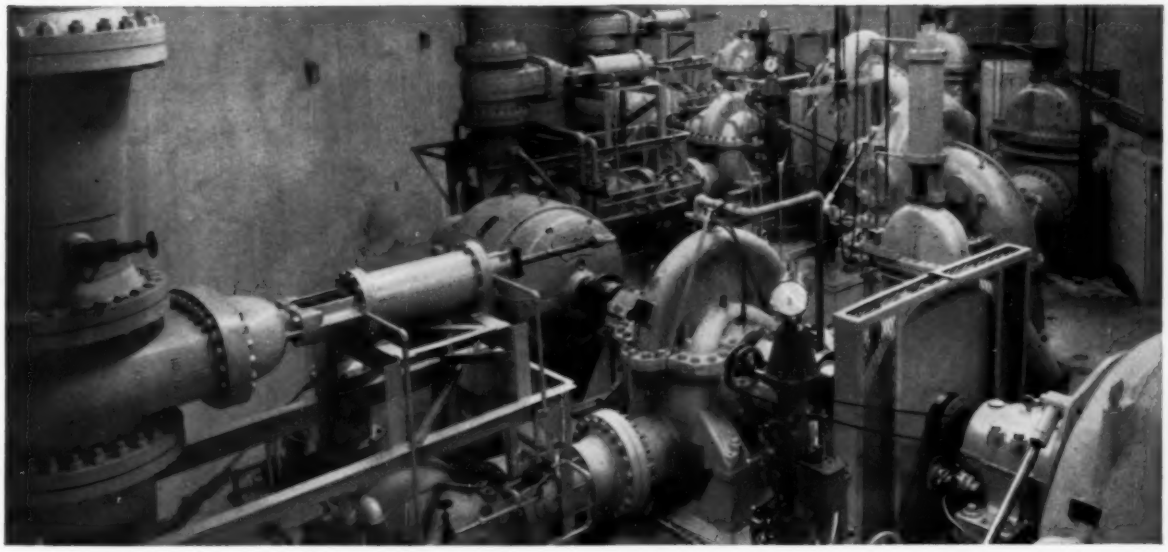

DARLING VALVES . . . *where top performance is a keynote*

MODERN planning and the latest in equipment facilities comprise a high efficiency team at the Washington Suburban Sanitary Commission's new Anacostia Sewage Pumping Station.

Note that the large Darling gate valves are cylinder operated and installed in both horizontal and vertical lines. These valves, with their fully revolving double disc parallel seat design, are particularly suited for such service. Not only are the seat faces automatically wiped clean during each operation, but the principle also assures uniform wear distribution, extended life and consistently tight closure.

Darling gate valves are available in a wide range of sizes and types for all normal and unusual services. Write for Bulletin 5710.

DARLING VALVE & MANUFACTURING COMPANY

Williamsport 11, Pa.

Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.

New Bulletins

CONTINUED FROM PAGE 100A

through a wide range of differential and static pressure.

Sixteen frequently used meters which meet flow measurement applications having broad static and differential pressure ranges are listed in table form, showing catalog, model and meter ring numbers, type mounting and meter description. Complete information on how to order these standard meters is included.

Activated Nuchar

334

Industrial Chemical Sales Div., West Virginia Pulp and Paper Co., New York, N. Y., has just published a 12-page booklet entitled "Powdered Activated Nuchar for Purification and Reclamation." The booklet offers helpful hints on the use of Nuchar for the removal of impurities and objectionable taste and odors and on Nuchar's ability to adsorb desirable materials which are to be recovered.

According to the booklet, Nuchar has been found to have many uses in a wide range of industries and products, including water works treatment, reclaimed rubber, alcoholic beverages, food, dry cleaning, electroplating, insecticide, plastics, fine chemicals and pharmaceuticals.

Triangle Brand Copper Sulphate

HELPS SOLVE YOUR WATER PROBLEMS

Triangle Brand Copper Sulphate economically controls microscopic organisms in water supply systems. These organisms can be eliminated by treatment of copper sulphate to the surface. Triangle Brand Copper Sulphate is made in large and small crystals for the water treatment field.

Roots and fungus growths in sewage systems are controlled with copper sulphate when added to sewage water without affecting surface trees.

Booklets covering the subject of control of microscopic organisms and root and fungus control will be sent upon request.

PHELPS DODGE REFINING CORPORATION

300 Park Avenue, New York 22, N. Y.
5310 W. Sixty-sixth St., Chicago 38, Ill.

Floating Roof Tank

335

The Nooter Corporation, St. Louis, Mo., has just released an illustrated brochure in which they describe a new patented seal hanger for their floating roof tanks.

The exclusive Nooter-Designed 2-point Suspension Seal Hanger is fully described in words and pictures. How it works, why it is easier to install, why it provides a more positive seal and why it assures minimum maintenance is explained in this new brochure.

The three popular types of floating roof tanks (double deck, pontoon and pan) are illustrated.

The brochure also describes Nooter's replacement service—any existing roof can be up-dated through the installation of the Nooter Seal.

Cast Steel Gate Valves

336

Walworth Company, New York, N. Y., has released a new, four-page illustrated bulletin describing 150-lb and 300-lb cast steel gate valves.

The bulletin lists ten features of the valves, stressing their durability, easy maintenance and erosion-resistant properties. It also provides dimension and weight charts and line drawings for each type.

The two-color bulletin presents, in text and by cutaway of a valve, such features as deep-stuffing boxes in all sizes and pressures to assure tightness and maximum packing life, gland eye bolts, mounted to swing aside to facilitate packing maintenance; cylindrical, bottom-seated rings with ample cross section to eliminate turbulence and reduce erosion and pressure drop; and body-to-bonnet joint for reassembly of the valves in the field without danger of misalignment.

The large cutaway of a valve shows how stem scoring is prevented through

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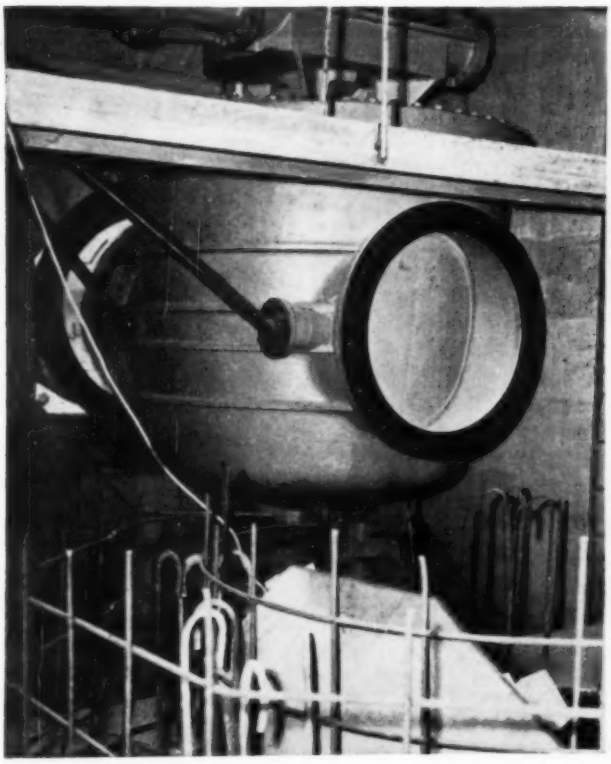


▲ Downhill view from Iron Mountain tunnel inlet shows first two conduits and pumping station, with reservoir and aqueduct in background. Excavation at right of pumping station will house third set of pumps, and third conduit will be added.

◀ This SMS-Rotovalve at Iron Mountain shows clearly the drop-tight shut-off position. In operation, the conical plug first lifts, then turns, finally reseats, giving you precise aperture control.

3 MORE SMS-ROTOVALVES ORDERED FOR PUMP DISCHARGE SERVICE AT IRON MOUNTAIN

As part of the expansion program for increasing the supply of water to southern California through the Colorado River aqueduct, three more SMS-Rotovalves have been ordered by the Metropolitan Water District of Southern California. These three 48″ x 64¼″ tapered Rotovalves, duplicates of six already installed at Iron Mountain Pumping Station, will be used for pump discharge service. Their inherent characteristics of a large reduction of flow area during the early part of the closing stroke make them ideally suited to control of surges in the event of emergency shut-off.

SMS-Rotovalves give the least possible pressure loss. In the open position, their full line opening offers no more resistance than a straight piece of pipe of the same diameter. Hydraulic unbalance and mechanical design make operation easy, and less powerful operators may be used. Rotovalves' flexibility suits them to any type of operation, any method of control, or any sort of location.

To obtain information on SMS-Rotovalves, as well as on the entire SMS line of Butterfly and Ball Valves, contact our nearest representative, or write S. Morgan Smith Company, York, Pennsylvania.

S. MORGAN SMITH HYDRODYNAMICS

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

2

Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

News of Suppliers

Dresser Appoints Sales Representatives

Dresser Manufacturing Division, Bradford, Pa., one of the Dresser Industries, Inc., has announced the appointments of C. E. Boston and William J. C. Marshall, Jr., as general markets sales representatives.

Mr. Boston will service Northern California and Western Nevada. Before joining Dresser, he was employed by Fenestra Inc., California, and Revere Copper & Brass, Inc., Detroit.

Mr. Marshall will represent the company in the New England states. He was formerly employed by Red Hed Manufacturing Co., Boston, and prior to that was Superintendent, Water & Sewer Departments, Plymouth, New Hampshire.

Simple design and rugged construction are outstanding features of the double disc gate assembly in M & H Valves. The gate consists of 2 bronze faced discs, 1 integral stem nut and spreader, and 2 direct-acting bronze spreaders.

When the valve is opened, the stem nut spreader and the direct-acting spreaders simultaneously release the pressure of the disc against the seats. This allows the dics to move laterally away from the seats and rise easily. When the valve is closed, the action of the discs and spreaders is simply reversed.

There is no sliding action of the discs on the seats either in opening or closing. With certain refinements, this mechanism is incorporated in M & H Square Bottom Valves which are especially designed for throttling purposes. Write or wire

M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA
SUBSIDIARY OF WALWORTH

DeZurik Moves New Jersey Office

DeZurik Sales Co., has moved its office from Maplewood, New Jersey to 24 Franklin Place, Summit, New Jersey, Phone: CRestview 7-3191. DeZurik Sales Company is the sales and service organization for DeZurik Corp. of Sartell, Minnesota.

Charles Hodgdon, for the past two years a Sales Engineer in the home office of DeZurik Corp., will be in charge of the Summit, New Jersey offices. In addition to supervising the activities of this office in the New York-New Jersey area, he will work with DeZurik valve representatives in Baltimore, Philadelphia, Boston, West Hartford and Syracuse to provide these offices with technical assistance.

Mueller Promotes Gannon To Sales Manager

Mueller Co., Decatur, Ill., has announced that Mr. Dan R. Gannon has been appointed General Sales Manager.

Gannon joined Mueller Co. in 1929 as a sales representative. He assumed the position of Southwest Sales Manager in 1953, taking up headquarters in Dallas, Texas. In 1955, he was appointed Western Sales Manager, directing West Coast sales activities from Los Angeles, California, offices.

He returned to Decatur early in 1957 to take up the duties of Field Sales Manager. Mr. Gannon has had experience in the water and gas industries.

Chalfant Heads Byers Sales

A. M. Byers Co., Pittsburgh, Pa., has announced that A. S. Chalfant, formerly director of steel sales is now general manager of sales. In his new position, Mr. Chalfant will direct and coordinate all of the firm's selling efforts.

Appointed to the new sales management staff were R. I. Enzian,

CONTINUED ON PAGE 106A

Palatable Water at LOW COST

A satisfactory palatable water is never achieved by halfway dosages of Aqua Nuchar Activated Carbon. To be certain that all odors are adsorbed, the correct amount of Aqua Nuchar *must* be applied. In the majority of plants where Aqua Nuchar is used, it has been found that 20 pounds or more are needed to give proper odor and taste control to 1,000,000 gallons of water. This, certainly, is inexpensive treatment.

Many plants are adopting the practice of continuous application of Aqua Nuchar, thus keeping the plant seeded. This gives assurance against development of odors within the plant due to decomposing sludge. Also, periods of sudden odor surges can be controlled with lower dosages than would be necessary if the plant were not already seeded with Aqua Nuchar.

To solve your water odor problem, call or write our nearest office. A member of our technical staff will work at your plant to help make the water palatable, at no cost or obligation on your part.

GOOD CARBON · GOOD WATER · GOOD WILL

New York Central Building
230 Park Ave., New York 17, N. Y.
Phila. Nat'l Bank Bldg.
Broad & Chestnut Sts., Phila. 7, Pa.

industrial CHEMICAL SALES
division west virginia pulp and paper company

Pure Oil Building
35 E. Wacker Drive, Chicago 1, Ill.
2775 S. Moreland Boulevard
Cleveland 20, Ohio

NEED LONGER FILTER RUNS?

Turn to N-Sol activated silica (coagulant aid) to meet demand for higher filtration rates. Improved sedimentation results from large dense floc formed with N-Sol. Coarser filter media therefore may be used.

N-Sol prepared in your plant with "N" sodium silicate and a reacting chemical. No charge for license under our N-Sol Process patents.

PQ SOLUBLE SILICATES

Trademarks Reg. U.S. Pat. Off.

PHILADELPHIA QUARTZ CO.
1166 Public Ledger Bldg., Philadelphia 6, Pa.
9 PLANTS • DISTRIBUTORS IN OVER 65 CITIES

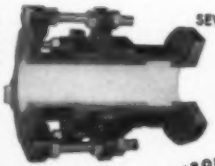
Crispin

AIR VALVES

...for maximum safety and efficiency in pipeline operations

Crispin Air Valves have these basic advantages — simplified construction, easy accessibility, maximum durability, minimum maintenance and thoroughly efficient operation.

Crispin DEEP WELL AIR VALVES adjustable screw top attached to Crispin Air & Vacuum Valves controls air flow to eliminate damaging float flutter.



Crispin SEWER AIR VALVES automatic, not manual, control of air in equipment used for the treatment and disposal of sewage.

Crispin SLIP JOINTS safe, fast way to remove and replace fixtures when repairing lines.

AIR CONTROL VALVES • FOR OVER 45 YEARS

multiplex
MANUFACTURING COMPANY
BERWICK, PENNSYLVANIA
Dept. B

Write, wire or phone for the facts on the complete line of Crispin Air Valves that provide safety and efficiency in your line operations.

manager wrought iron sales; F. E. Farnan, manager sales promotion; and R. J. Bricmont, manager engineering service. Supplementing this group is Harry R. Rowland, former vice president, A. M. Byers Co., and now a consultant on wrought iron sales.

Prior to joining Byers several months ago, Mr. Chalfant was executive vice president and sales manager of McDowell Manufacturing Company and also a director of that firm. He has also been associated in various sales and executive positions with Hanlon & Wilson Co. and U. S. Steel Corp.

Cochrane Succeeds Broggi As President Neptune Meter

Neptune Meter Co., New York, N. Y., has announced that Mr. William H. Cochrane has been elected president succeeding Mr. Dante E. Broggi.

The company stated, that Mr. Broggi in submitting his resignation as president and director expressed the desire to be relieved of the detailed responsibilities of management to enable him to devote most of his time to outside personal interests. He will continue to serve as a consultant to Neptune.

Prior to his election as president, Mr. Cochrane was executive vice president of Neptune responsible for coordinating policies and operations affecting administration, manufacturing and sales activities among Neptune and its subsidiary companies.

Dorr-Oliver Opens Office In Kansas City

Dorr-Oliver Inc., Stamford, Conn., has announced the opening of a new midwest sanitary sales office at 4117 Broadway in Kansas City, Missouri. Centrally situated, the new office will enable the company to provide better service for engineers and consulting firms in the states of Missouri and Kansas.

Joseph V. Swift, named manager of the Kansas City office, has been transferred from the Southeastern

Division, Atlanta, Georgia where he has handled D-O sanitary sales over the past four years. Mr. Swift joined the company in 1952 upon graduation from the University of Alabama as a civil (sanitary) engineer.

Sales Engineer Lee Roy H. Walter, also assigned to the new Kansas City office, is a civil engineering graduate of the University of Kansas and a native of that state. Prior to joining Dorr-Oliver's Sanitary Sales staff in July, 1957, he spent eight years as sanitary engineer with the Kansas State Board of Health, Divi-

Robinson Named Clay Pipe Assn. President

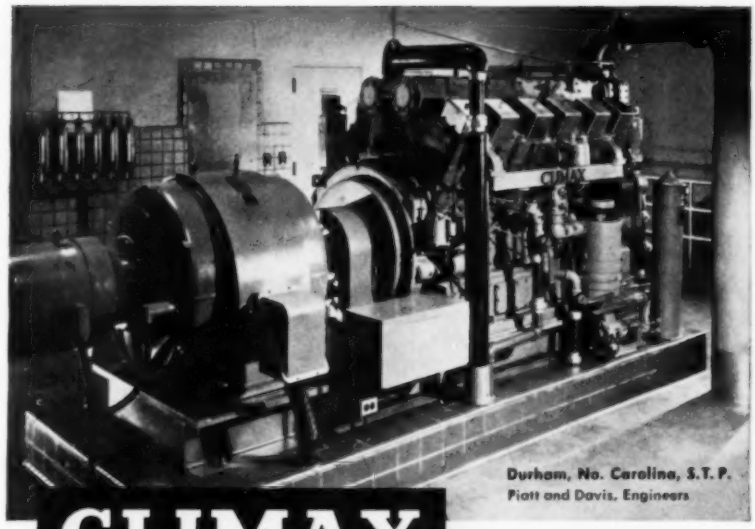
The Board of Directors of The National Clay Pipe Manufacturers, Inc. has announced the election of G. A. Robinson of Washington, D. C. as president.

Mr. Robinson moves into the top executive position of this National assn. of the clay pipe producers succeeding D. M. Strickland, who retired this year. Mr. Strickland was elected a Vice-President and will serve as a consultant to the Board of Directors.

For six years Vice-President in Charge of Washington Activities and Government Relations with the Association, Mr. Robinson brings a vast background of experience into his new executive post.

Prior to joining NCPMI in 1951, he directed the activities of the G. A. Robinson Associates, a group of sales engineers with headquarters in Washington, D. C., representing various manufacturers of electrical, mechanical, heating and chemical engineering equipment in the Middle and Southeastern United States.

Prior to that he was an Assistant to the Chief Power Engineer for the Stone and Webster Engineering Corp; The Engineer Contractor for the Clinton Engineer Works, which included the construction of the city of Oak Ridge, all utilities and the great electromagnetic atomic bomb project at Oak Ridge, Tenn.



Durham, No. Carolina, S.T.P.
Platt and Davis, Engineers

CLIMAX

POWER

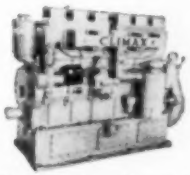
FOR SEWAGE TREATMENT PLANTS...

Climax engines can be found on the job every day of the year in hundreds of sewage treatment plants from coast to coast—powering sewage pumps, blowers and generators. Tremendous savings are being realized by using readily available **sludge gas** for fuel and also by utilizing heat from the jacket water and exhaust gas of the engines to heat digesters and buildings. When a shortage of sludge gas is encountered these engines operate on an auxiliary fuel—either gasoline, butane or natural gas, or a combination thereof. Eight Climax engines are available for continuous duty service in Sewage Plants in a range of sizes from 40 to 300 hp.—for standby service up to 605 hp. max. rating.

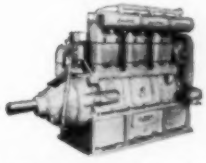
Write today for complete information, bulletins or engineering consultation.

V-125—12 cylinder, 605 max. H.P. at 1200 R. P. M.
V-122—12 cylinder, 520 max. H.P. at 1200 R. P. M.

V-85—8 cylinder, 390 max. H.P. at 1200 R. P. M.
V-80—8 cylinder, 340 max. H.P. at 1200 R. P. M.



K-75—6 cylinder, 302 max. H.P. at 1200 R. P. M.
K-67—6 cylinder, 265 max. H.P. at 1200 R. P. M.



R-165—6 cylinder, 192 max. H.P. at 1200 R. P. M.

CLIMAX ENGINE MANUFACTURING CO.
DIVISION OF WAUKESHA MOTOR COMPANY
FACTORY – CLINTON, IOWA

We took a tip from a typist

The question came up at a Heads-of-Departments meeting. Production told Personnel that his new typist asked that a portion of her salary be set aside for U. S. Savings Bonds. Could it be arranged?

This one question posed another: How many more employees, like the typist, would like to buy Savings Bonds automatically through Payroll Savings, yet, were not aware that we've had a Plan for years?

Finding out was simple.

A phone call brought the assistance of our State Savings Bond Director. He helped plan a company-wide campaign, and provided all the materials to inform our people about the advantages of U. S. Savings Bonds. Everyone received an application card.

The upshot? Employee participation shot up to the highest percentage since the mid-Forties. And the whole program was conducted in good order. Work was never interrupted.

Today there are more Payroll savers than ever before in peace time. Look up your State Director in the phone book or write: Savings Bonds Division, U. S. Treasury Dept., Washington, D. C.

WATER & SEWAGE WORKS

THE U. S. GOVERNMENT DOES NOT PAY FOR THIS ADVERTISEMENT. THE TREASURY DEPARTMENT THANKS, FOR THEIR PATRIOTISM, THE ADVERTISING COUNCIL AND THE DONOR ABOVE.

New Bulletins

CONTINUED FROM PAGE 102A

sufficient clearance for the one-piece gland between the gland, stem and stuffing box. Streamlined ports for minimum pressure drop are clearly shown. There are also integral guide rib faces for self-centering of wedges.

Controlled Volume Diaphragm Pumps

337

Milton Roy Company, Philadelphia, Pa., has just published a new bulletin on their metering pump with diaphragm liquid end. This two-page bulletin specifies capacities, pressures and materials of construction of the lead-proof pump for metering corrosive, obnoxious or toxic chemicals. It also describes the features of the pump including the mechanical actuation for correcting the volume of hydraulic fluid between each stroke.

Vertical Boom Ditcher

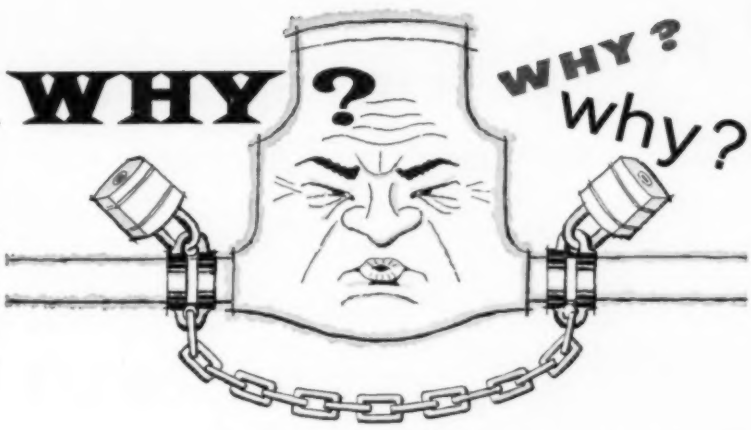
338

Barber-Greene Company, Aurora, Illinois, has published an attractive 16-page, two color booklet which describes in detail, the new vertical boom addition to their ditcher line.

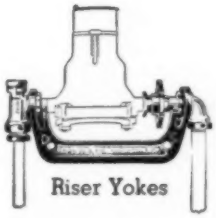
Among the many machine features which are described and illustrated by photographs and drawings are: Dual range "Hydra-Crowd", all hydraulic crowding transmission: a unique, flexible draw-bar system which reduces strain and twist on the digging boom when the machine is digging on uneven ground, or traversing a curve; a new-type bucket line drive, eliminating long wrap-around drives and equalizing contact to each side of the boom; a hydraulically operated spoil conveyor: new crawlers of improved design; and a unique, rheostat controlled electric overload protection device.

A center, two-page spread in the folder is devoted to an oversize photograph of the machine with all salient details recapitulated and identified as to their location on the machine. Condensed specifications of the Model 784 have also been made a part of the booklet.

CONTINUED ON PAGE 110A



SHACKLE YOUR WATER METERS?


Riser Yokes

Angle Yokes

Straight Line Yokes

Ordinary old-fashioned meter couplings are frequently like shackles on your water meters. They often make meter changing so difficult and troublesome that periodic testing is omitted and proper meter maintenance neglected.

Be sure to set your meters the modern way. See that Ford Yokes are keeping every meter available for fast, fast, FAST changing and testing. Savings in time and increases in revenues can be really substantial.

You can change a meter in a Ford Yoke

EASILY

There are models for every condition. Send for free catalog.

FORD — FOR BETTER WATER SERVICES

THE FORD METER BOX COMPANY, INC. Wabash, Indiana

HYDRO-TITE

DEPENDABLE JOINTING COMPOUND

Seals Bell and Spigot Water Mains

Economical—Effective

Over 35 Years Of Dependable Performance

HYDRAULIC DEVELOPMENT CORP.

MAIN SALES OFFICE 50 CHURCH ST., N. Y. C.

General offices and works W. Medford Sta., Boston, Mass.

For Important Information
on Products and Services
see the 1957-1958
WATER & SEWAGE WORKS
REFERENCE and DATA NUMBER

The following firms have information of interest to you in the 1957-58 REFERENCE and DATA NUMBER

Airkem, Inc.
Alabama Pipe Co.
Allis-Chalmers
Amercoat Corp.
American Vitrified Prod. Co.
American Well Works
Anthracite Equipment Co.

Bailey Meter Co.
Beaumont Birch Co.
Bethlehem Steel Co.
B-I-F Industries, Inc.
Borden Metal Products Co.
Builders-Providence Inc.
Byron Jackson Pumps, Inc.

Chain Belt Co.
Chicago Bridge & Iron Co.
Chicago Pump Co.
Clarksville Foundry & Machine Works
Jas. B. Clow & Sons (Iowa)
R. D. Cole Mfg. Co.
Columbia Southern Chem. Co.
Combustion Engineering, Inc.
Cook Well Strainer Co.

Dorr-Oliver, Inc.

Fischer & Porter Co.
Foster Eninecring Co.

General Chem. Div.
Allied Chem. & Dye Corp.
General Filter Co.
Golden-Anderson Specialty Valve Co.
Graver Tank & Mfg. Co.
Graver Water Conditioning Co., Inc.

Hardinge Co., Inc.

Infilco, Inc.
Ingalls Iron Works Co.
International Minerals & Chemical Corp.
Iowa Valve Co.

Jeffrey Mfg. Co.
Johns-Manville
John Wiley Jones Co.

Komline-Sanderson Engineering Corp.

Link-Belt Co.
Ludlow-Rensselaer Valve Mfg. Co.

M & H Valve & Fittings Co.
Millipore Filter Corp.
Morse Boulger Destructor Co.
Multiplex Mfg. Co.

Natco Corp.
National Clay Pipe Mfrs., Inc.
National Power Rodding Corp.
Neptune Meter Co.
Nichols Engineering & Research Corp.

Olin-Mathieson Chemical Co.
Omega Machine Co.

Pacific Flush Tank Co.
Pennsalt Chemical Corp. (Western Div.)
Permutit Co.
Phipps & Bird, Inc.
Henry Pratt Co.
Presstite-Keystone Engineering Products Co.
Pressure Concrete Co.
Proportioneers, Inc.

Rensselaer Valve Co.
Roberts Filter Mfg. Co.

Schramm, Inc.
Simplex Valve & Meter Co.
Smith & Loveless, Inc.
S. Morgan Smith Co.
A. P. Smith Mfg. Co., Inc.

Tennessee Corp.

U. S. Pipe & Foundry Co.

Walker Process Equipment, Inc.
Wallace & Tiernan, Inc.
Washington Aluminum Co.
Water Seals, Inc.
Western Machinery Co.
White Diesel Engine Div.
Worthington Corp.

Yeomans Bros. Co.

SCRANTON PUBLISHING COMPANY, INC.
185 N. WABASH AVE., CHICAGO 1, ILL.
155 E. 44th ST., NEW YORK 17, N. Y.

SCRANTON GILLETTE PUBLICATIONS

WATER & SEWAGE WORKS • INDUSTRIAL WASTES
REFERENCE and DATA NUMBER • MODERN HIGHWAYS

New Bulletins

CONTINUED FROM PAGE 109A

Rotary Displacement Pump

339

Manton-Gaulin, Everett, Mass., has announced the publication of a Bulletin, on the new Gaulin "Twin-Lobe" Rotary Positive Displacement Pumps. It is part of the Gaulin Technical Assistance program which provides information and data on pumping and controlling materials with Gaulin Particle Control.

The bulletin presents the features and operating characteristics of the recently developed Gaulin Twin-Lobe Pump. Special emphasis is placed on a unique cosine rotor development called the Twin-Lobe design. It is said to have unusual simplicity and efficiency of operation, and is described and illustrated in detail. Twin-Lobe rotors are keyed to a rotating shaft and each of the lobes draws in a new volume of material with each 180 degrees of rotation, providing the positive displacement. The Cosine rotor principle provides a rate of delivery which is constant throughout the full range of discharge pressures. Only three moving parts are used.

The new bulletin provides a complete analysis of performance characteristics, graphs on operating speeds and ranges, corrosion resistance charts, data on seals, and specifications for determining pump size, speed and horsepower.

Control of Levels

340

Robertshaw-Fulton Controls Co., Instrument Division, Philadelphia, Pa., has published an illustrated booklet describing in detail the measurement and control of level in industrial processes.

Purpose of the new booklet, the announcement said, is to familiarize en-

WANTED

Experienced Engineers to prepare plans for Water Filtration Plants and/or Sewage Treatment Plants. State experience, salary requirements and when could report. Box 1100, Water & Sewage Works, 185 North Wabash Ave., Chicago 1, Illinois.

gineering and management personnel with the latest techniques and equipment for level measurement.

The 16-page booklet covers applications of the company's capacitance-type devices in quantitative measurement and control of granular solids, liquids, powders and interface. Several specific industry uses are described.

The full line of level instrumentation and systems includes a variety of indicators, recorders, controllers, and probes, which are described by the manufacturer as the "heart of the measuring system."

Serving Industry

341

Philadelphia Quartz Company, Philadelphia, Pa., has issued a handy 16 page folder, "Serving Industry". It is a catalog in miniature listing many of the important liquid and dry sodium and potassium silicates with their physical and chemical properties.

Discussions treat such applications as coagulant aids in raw and waste waters, adhesives, soap and detergent builders, cements, sizes and coatings. Chart lists pH valves and chief advantages in various processes together with the silicate property applicable to the use cited.

High Capacity Chlorinator

342

Fischer & Porter Co., Hatboro, Pa., has just released a 20-page catalog describing the features, construction and application of vacuum-type, solution-feed, high capacity gas chlorinators.

According to the catalog, this chorinator is suitable for manual, semi-automatic operation in capacities from 60 to 8,000 pounds of chlorine per 24 hours.

Two Chances

You have two chances—
One of getting the germ
And one of not.

And; if you get the germ
You have two chances—
One of getting the disease,
And one of not.

And; if you get the disease,
You have two chances—
One of dying,
And one of not,

And; if you die?—Well,
You *still* have two chances.

GUNITE does it **2** times as fast at **1/2** the cost

"Gunite" is the modern process (sand and cement applied pneumatically) for repairing, constructing, lining:

- Reservoirs
- Dams
- Filter Plants
- Sewage Disposal Plants
- Tanks
- Stadiums
- Bridges
- Sea Walls
- Swimming Pools, etc.

WRITE FOR MORE INFORMATION, INCLUDING 48 PAGE "GUNITE" BOOKLET.

PRESSURE Concrete Co.

FLORENCE, ALA. 1555 Helton Street

OTHER OFFICES IN

CHICAGO, ILL. 30 W. Washington Street

NEWARK 5, N. J. 193 Emmet Street

For Simplicity of Installation, Operation, and Maintenance, SPECIFY . . .

Sparling 906

One meter... Dual Application

CAN BE MOUNTED AS A MANHOLE METER OR WELDED SADDLE

The rugged, dependable Sparling 906 represents a new concept of meter installations. The 906 meterhead assembly is mounted directly on a standard AWWA flanged "T" or flanged manhole outlet for immediate operation . . . as a Welded Saddle Meter, it's furnished with a fabricated saddle permitting the meter to be mounted easily on an existing steel pipe. In saddle application, weight is reduced considerably and installation is simple. Sizes 16 to 72 inches.

OTHER OFFICES:
Atlanta • Chicago • Cincinnati
Dallas, Texas • Kansas City, Mo.
Los Angeles • Roselle, N. J.
San Francisco • Seattle • Toronto, Can.
Romford, England

☐ Yes! We are interested in increasing our metering efficiency. Send us more information . . . no obligation, of course.

☐ Also send information on Sparling's line of Water Control Equipment.

Name_____

Company_____

Address_____

City_____ Zone_____ State_____

Send to: SPARLING METER COMPANY
229 N. Temple City Blvd., El Monte, California

Helpful Bulletins *Available Free*

Primary Elements Catalog

343

Burgess-Manning Co., Penn Instruments Div., Philadelphia, Pa., has just published a 16-page Primary Elements Catalog #1, the first catalog of its kind.

SK's Instrument Division Products

344

Schutte and Koerting Company, Cornwells Heights, Pa., has announced the publication of Bulletin M-1, a condensed bulletin on Rotameters and Flow Instruments which pictures and briefly describes the division's line of precision instruments for measuring, indicating, recording, and controlling the rate of flow of all types of fluids.

Dual Valve Sludge Pumps

345

Komline-Sanderson Engineering Corp., Peapack, New Jersey, has just released a four-page bulletin on its Diaphragm and Plunger Type-Dual Valve Sludge Pumps.

Ball Joint Pipe

346

American Cast Iron Pipe Co., Birmingham, Ala., has just published a catalog on the American Molox Ball Joint Pipe.

Chemicals Used in Water, Sewage and Waste Treatment

347

Omega Machine Co., B-I-F Industries, Providence, R. I., has just released a revised, and up-to-date issue of their Technical Bulletin on Chemicals Used in Water, Sewage and Waste Treatment.

Pneumatic Sewage Ejectors

348

The Komline-Sanderson Engineering Corp., Peapack, New Jersey has just published a bulletin on its new Pneumatic Sewage Ejector.

Type S Controller

349

Simplex Valve & Meter Co., Lancaster, Pa., has published a comprehensive and well documented 12-page bulletin on the Type S controller. This bulletin will be of interest to engineers, operating and maintenance personnel of municipalities, public works plants, processing industry plants, etc. dealing with water usage and its conservation. Valuable data on details of design, capacities, dimensions, and typical installations are included.

Industrial pH Handbook

350

The Process Instruments Division of Beckman Instruments, Inc., Fullerton, Calif., has announced the availability of **"The Industrial pH Handbook."**

Water Works Valve-Hydrant Catalog

351

Darling Valve & Manufacturing Company, Williamsport, Pa., has just published a 72-page catalog-type bulletin, giving detailed, up-to-the-minute information on gate valves, check valves and hydrants especially developed and produced for Water Works Service.

Instrument Accessories And Supplies

352

The Foxboro Company, Foxboro, Mass., has announced that complete information on industrial instrument **Accessories and Supplies** has been compiled in a new 60-page catalog, available to Foxboro Instrument users. The loose-leaf book, includes specifications, part numbers and prices for more than 250 commonly furnished instrument parts and supplies.

Cut-In Valves

353

Golden-Anderson Valve Specialty Company, Pittsburgh, Pa., has just issued a new four-page bulletin describing their **Cushioned Emergency Cut-In Valve.**

Water & Sewage Gates

354

Armco Drainage & Metal Products, Inc., Middletown, Ohio, has available a new illustrated bulletin showing how their complete line of **Gates** meets municipal water and sewage control requirements.

Ductile Iron Valves

355

Kennedy Valve Mfg. Co., Elmira, N. Y., has just published a new bulletin describing in detail **Kennedy Ductile Iron Valves.**

Bronze Goods Catalog

356

Pubco Bronze, Los Angeles, Calif., has just released a new Bronze Goods Catalog covering their line of Corporation Stops, Service Stops, Curb Stops, Fittings and Valves.

Valve Sizing Charts

357

Jordan Corporation, Cincinnati, Ohio, has just published a 4-page bulletin on **Sizing Charts.**

Rotary Compressors

358

Davey Compressor Co., Kent, Ohio, has released a bulletin showing component parts of its new **Hydrovane Rotary Compressors.**

Rust Prevention Systems

359

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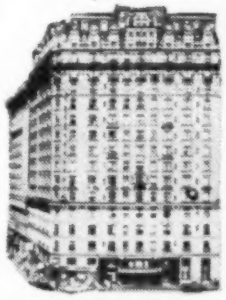

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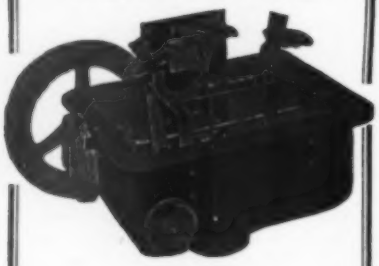

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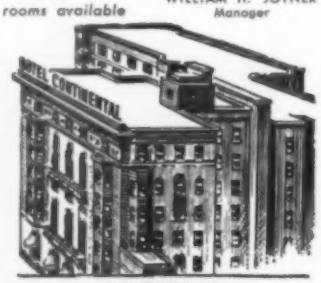

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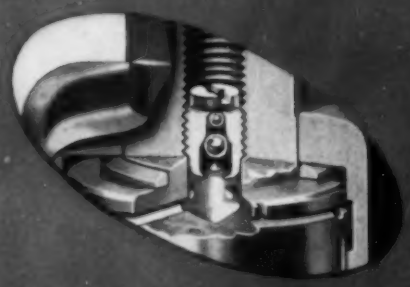

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